MH-A

ISSN 0374-7859

THE GARDENS' BULLETIN SINGAPORE

Volume XXXV
(1982-1983)

A periodical reflecting the interests and activities of the Botanic Gardens Singapore

To be purchased at the Botanic Gardens
Cluny Road, Singapore 1025

Published by Botanic Gardens
Parks & Recreation Department
Singapore

CONTENTS

Vol. XXXV

THE GARDENS' BULLETIN
SINGAPORE

VOL. XXXV (Part 1) 1st June 1982

CONTENTS

Published by the Botanic Gardens
Parks and Recreation Department
Ministry of National Development
Singapore 1025

Printed by General Printing & Publishing Services Pte. Ltd.

GARDENS' BULLETIN

EDITORIAL COMMITTEE

The Gardens' Bulletin is published twice yearly by the Parks & Recreation Department, Ministry of National Development, Singapore. Neither the Parks & Recreation Department nor the Editorial Committee is responsible for the opinions or conclusions expressed by the contributing authors.

The price of the Gardens' Bulletin varies according to the content of each issue. This issue is priced at Sing. $17.60 excluding postage. Overseas subscribers are requested to make payment in the form of bank drafts or international money orders in Singapore currency payable to the *Commissioner of Parks and Recreation, Singapore.*

All correspondence concerning advertisements and exchange should be addressed to:

The Business Manager
Gardens' Bulletin
Botanic Gardens
Parks and Recreation Department
Singapore 1025

Instructions for contributing authors are found on the inside of the back cover.

THE GARDENS' BULLETIN
SINGAPORE

VOL. XXXV (Part 1) 1st June 1982

CONTENTS

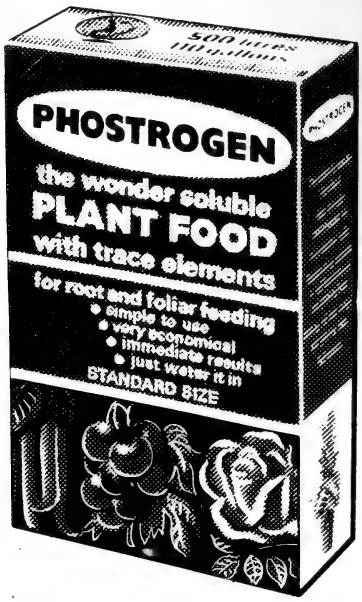
Published by the Botanic Gardens
Parks and Recreation Department
Ministry of National Development
Singapore 1025

Effective-publication date: 17th August 1982

SIMPLY APPLY
PHOSTROGEN

WHENEVER YOU READ A RECOMMENDATION TO USE...

A LIQUID MANURE OR FEED
A FOLIAR FEED
A GENERAL FEED
A SOLUBLE PLANT FOOD
A TOMATO FOOD
A LAWN FERTILISER
A POT PLANT FOOD
A TOP DRESSING
A ROSE FERTILISER
A SPECIFIC FERTILISER OF ANY KIND
AN IMPOVERISHED SOIL RESTORER
A HYDROPONIC NUTRIENT
A HOME MADE SOIL-LESS COMPOST
A NUTRIENT REPLENISHMENT FOR SOIL-LESS COMPOSTS AND GROWING BAGS



PHOSTROGEN is an economical and genuine all-purpose plant food that gives excellent results with seeds, seedlings, cuttings, fruit, vegetables, indoor plants, orchids, shrubs, hedges and even established trees. It is also a highly effective cut flower preservative. Use PHOSTROGEN in three different ways: for root feeding, as a top dressing and — because it contains essential trace elements — as a foliar feed too.

Also available as

PHOS-TRO-TABS PLANTOIDS

PHOSTROGEN in slow-release tablet form. Recommended for all house plants and individual subjects in the greenhouse and garden. Ideal for hanging baskets, window boxes and other often difficult-to-reach locations.

Sole Agent:

Garden Supplies Centre (Pte) Ltd

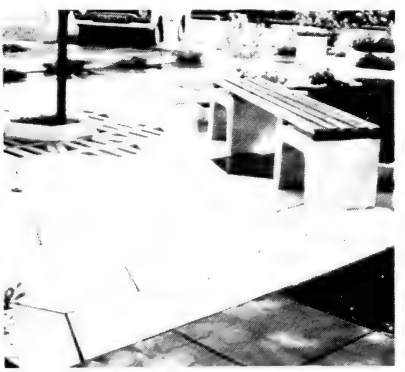
617, BUKIT TIMAH ROAD SINGAPORE 1026 TEL: 672821
BRANCH: PLOTS 11&12 JOAN RD (OFF THOMSON RD) SINGAPORE 1129 TEL: 2513131
TELEX: GARCEN RS 35451. CABLE: "LANDSCAPE"

PHOSTROGEN PRODUCTS ARE OBTAINABLE AT:

TANGS•EVERSHINE FLORIST•FAR EAST ORCHID•FLORAMIST•HANDY-MAN CENTRE•HANDY-TOOLS LTD INTERNATIONAL DISPENSARY•JASON FLORIST•KATONG FLOWER SHOP•LES FLORIST•LIAN KHIONG TRADING LOVE FLORIST•MELINA FLORIST•PET LOVERS' CENTRE•SINGAPORE ORCHIDS•SONG LANG GARDEN SPA (PTE) LTD•SUNNY FLORIST•TERRA PTE LTD•VERONICA FLORIST (COLD STORAGE)

ROCK-HARD, COLOURED CONCRETE PAVING SYSTEM FOR LANDSCAPING

MONOLOK DRIVEWAY



MONOHEX FOR CARPARKS

METRIC 4-SQUARE FOOTPATH

SUPER HEXPOT ACCESS ROAD

MONOLOK Precast Concrete S-shape interlocking paving blocks produced locally in 60mm, 80mm and 100mm thickness, are suitable for pedestrian walkways, driveways and industrial pavements.

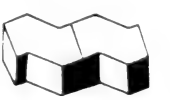
It is manufactured from no-slump concrete with a balanced mix design containing well graded aggregates, synthetic pigment and quality (polymer) concrete chemicals. The vibro compaction process ensures early high-strength gain up to 50N/mm^2 and high-wear resistance.

Installation is normally without any mortar on 50 mm loosely spread sandbed, however a well compacted crusher run base and firm edge restraint (kerb) are required.

This paving system includes a range of coloured standed blocks, radial set, end and edge stones. It is ready for foot or vehicular traffic immediately after laying and mechanical compaction.

Other concrete landscaping products manufactured: **MONOHEX** hexagonal (perforated) 100mm slabs for carpark, **SUPER HEXPOT** for turfed emergency roads. **METRIC 4-SQUARE** (½sq m) slabs for footpaths and 300mm by 300mm by 50mm square **TILES** for raised floors on concrete roof.

Call us now for a no-obligation quotation. All you have to do is send us your site plan and we will prepare installation sketches and prices for your consideration.



CASCON PTE LTD

25 Senoko Loop. Singapore 2775
Tel: 2577322 Telex: RS 36690

HUP SOON

OFFICE ADDRESS	:	102-B BEAUTY WORLD PARK OFF BUKIT TIMAH ROAD 7½MS SINGAPORE 2159
TELEPHONE	:	662450
FACTORY ADDRESS	:	70, UPPER JURONG ROAD 14½ MS TRACK 40 SINGAPORE 2263

MANUFACTURER

ALL KINDS OF EARTHENWARE MANUFACTURED BY MACHINE : RUBBER CUPS, ORCHID POTS, FLOWER POTS, SOFT PIPES AND DRAIN PIPES.

DEALER AND SUPPLIER

AGRI-HORTICULTURAL CHEMICALS AND GARDENING EQUIPMENTS.

VARIOUS KINDS OF CROCKERY WARES AND KITCHEN UTENSILS TO FACTORIES, CANTEEN, OFFICES AND RESTAURANTS.

AGRICULTURAL CHEMICALS

FERTILIZERS
Organic Fertilizers-Hortimeal Compound
Fertilizers-15, 15, 15 Etc.
Straight Fertilizers-Urea
Rock Phosphate M.O.P.A.S., Etc.
Foliar Fertilizers-Vilagro N.P.K. & 72

FUNGICIDES
Captan, Thiram, Agrithane M/46, Ziram,
Zineb, Maneb, Carbendazin, Benomyl.

INSECTICIDES
Dimethoate, Trichlorfon, Diazinon, Malathion,
Carbaryl, Bisectrex Methomyl 90%

HERBICIDES
Paraquat 24% , Dalapon, Selective &
Residual Herbicide Industrial Weed Control
Services. Agricultural Tools & Equipments.

Herbicides, Equipments, Etc.

OFFICE TEL: 7695 051, 7695 052
186 Chua Chu Kang Rd., 11ms. Private Lot 36
Comfort Garden, S'pore 2368. Cable: ASGRITCO

亞洲農業供應貿易公司
ASIATIC AGRICULTURAL SUPPLIES & TRADING CO.

KAR WAH TRADING COMPANY

17, THOMSON HILLS DRIVE

SINGAPORE 2057

TELEPHONE: 4528314

WE ARE SUPPLIER OF

Spare Parts

Lawn Mowers

Grass Cutting Machines

Hardwares

PARKS AND RECREATION DEPARTMENT

PUBLICATION FOR SALE

	TITLE	PRICE PER COPY*
☐	Selected Plants & Planting for a Greener Singapore	$0.60
☐	Selected Plants & Planting for a Garden City – Forty Shrubs	$1.20
☐	Selected Plants & Planting for a Garden City – Forty Climbers	$3.00
☐	A Revised List of Plants for Sale	$0.30
☐	A Guide to the Aeration of Trees	$1.00
☐	Bukit Timah Nature Reserve	$0.60

Requests for the publications should be addressed to the Commissioner of Parks & Recreation, Maxwell Road, Singapore 0106, Republic of Singapore.

For overseas orders, payment should be by bank draft or International Money Order and made payable to the Commissioner of Parks & Recreation, Singapore.

* Prices quoted are in Singapore Dollars.
For overseas orders – postage extra.

Maclurodendron: A New Genus of Rutaceae from Southeast Asia

T. G. HARTLEY
Herbarium Australiense
C.S.I.R.O. Division of Plant Industry
Canberra, Australia 2601

Abstract

The new rutaceous genus *Maclurodendron* consists of six species and ranges from Sumatra and the Malay Peninsula east to the Philippines and north to Vietnam and Hainan Island. The genus is described and its distinguishing features and apparent relationships are discussed. The six species are keyed, described, and their apparent relationships are outlined. New combinations are made for the names of three species, *Maclurodendron porteri, M. obovatum,* and *M. oligophlebium,* all of which were previously described in the rutaceous genus *Acronychia,* and three species, *M. pubescens, M. parviflorum,* and *M. magnificum,* are described as new.

Introduction

Among the previously described species excluded from *Acronychia* J. R. & G. Forst. in my revision of that genus (1974) are *A. porteri* Hook. f., described from W. Malaysia, *A. obovata* Merr., from the Philippines, and *A. oligophlebia* Merr., from Hainan Island. These three species plus three others that are undescribed, one from W. Malaysia and two from E. Malaysia, comprise a morphologically isolated group of plants that has not been previously recognised. The purpose of this paper is to give a taxonomic account of this group, which is here described as a new genus.

Geographically, these plants range from Sumatra and the Malay Peninsula east to the Philippines and north to Vietnam and Hainan Island (Fig. 1). To *Acronychia,* which ranges from India to southwestern China and throughout Malesia to eastern Australia and New Caledonia, they are similar in a number of characters, including their opposite leaves, 4-merous flowers, biovulate carpels, and syncarpous, drupaceous fruits. *Sarcomelicope* Engl. (including *Bauerella* Borzi; see Hartley, in press), which ranges from eastern Aus-

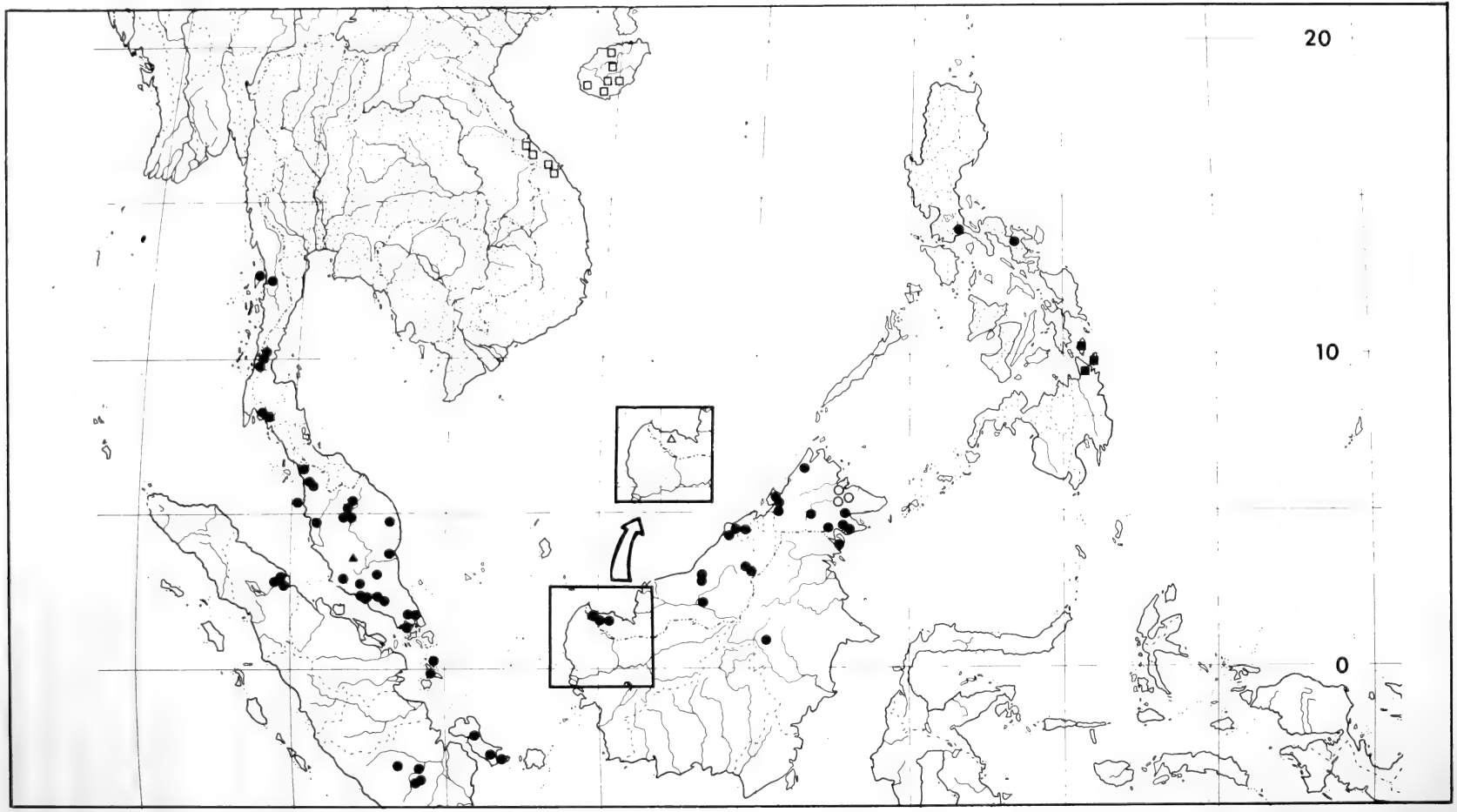


Fig. 1. Distributions of *Maclurodendron* species: *M. porteri* (dots), *M. pubescens* (circles), *M. obovatum* (solid squares), *M. oligophlebium* (open squares), *M. parviflorum* (open triangle), and *M. magnificum* (solid triangle).

Table 1.
Distinguishing characters of the genera *Acronychia, Sarcomelicope,* and *Maclurodendron.*

	Acronychia	*Sarcomelicope*	*Maclurodendron*
Leaves	opposite, trifoliolate or unifoliolate	opposite or verticillate, unifoliolate	opposite, unifoliolate
Flowers	bisexual	unisexual	unisexual
Petals	valvate, deciduous or rarely semi-persistent in fruit	imbricate, persistent or rarely semi-persistent in fruit	imbricate, deciduous in fruit
Staminal Filaments	ciliate toward the base or rarely eciliate, gradually tapering from a rather broad base to a subulate apex, becoming reflexed, deciduous in fruit	ciliate or ciliolate, elliptic-oblong, becoming straight, persistent or rarely semi-persistent in fruit	glabrous, sublinear, curved inward, minutely geniculate at the apex, deciduous in fruit
Fruits	axially syncarpous (the carpels otherwise separated by septicidal fisures) to completely syncarpous (the carpels connate throughout their length)	subapocarpous (the carpels basally connate but otherwise distinct and divergent) to completely syncarpous	completely syncarpous

tralia to New Caledonia and Fiji, is apparently the closest genus morphologically. It is similar in having unifoliolate leaves, unisexual, 4-merous flowers, imbricate petals, bi-ovulate carpels, and drupaceous fruits, among other characters. The major differences between *Acronychia, Sarcomelicope,* and the group under study here are given in Table 1.

Although *Sarcomelicope* and *Maclurodendron* are morphologically close, their geographic ranges are so dissimilar that I doubt if they are directly related. They may, however, have evolved independently from a common ancestral group. Both have seeds with spongy tissue in the outer testa and this, as I have given evidence for in a revision of *Sarcomelicope* (in press), suggests derivation from a dehiscent-fruited group resembling the Indo-Pacific genus *Melicope* J. R. & G. Forst.

This study is based on herbarium specimens. The contributing herbaria, with abbreviations from Holmgren and Keuken's *Index Herbariorum,* Part 1, ed. 6 [Reg. Veg. 92 (1974)] , are as follows: Arnold Arboretum of Harvard University, Cambridge (A); Bernice P. Bishop Museum, Honolulu (BISH); British Museum (Natural History), London (BM); Herbarium Bogoriense, Bogor (BO); Queensland Herbarium, Brisbane (BRI); Forest Research Institute and Colleges, Dehra Dun (DD); C.S.I.R.O. Herbarium Australiense, Canberra (CANB); Gray Herbarium of Harvard University, Cambridge (GH); Royal Botanic Gardens, Kew (K); Rijksherbarium, Leiden (L); Department of Forests, Lae, Papua New Guinea (LAE); National Herbarium of Victoria, Melbourne (MEL); University Herbarium, University of Michigan, Ann Arbor (MICH); National Herbarium of New South Wales, Sydney (NSW); New York Botanical Garden, New York (NY); Muséum National d'Histoire Naturelle, Paris (P); Herbarium, Botanic Gardens, Singapore (SING); Botanical Museum & Herbarium, Utrecht (U); Herbarium of the University of California, Berkeley (UC); National Museum of Natural History (Department of Botany), Smithsonian Institution, Washington, D. C. (US); and Naturhistorisches Museum, Wien (W).

Maclurodendron Hartley, gen. nov.

Plantae ligneae ut videtur dioicae; indumento brunneola vel ferruginea, trichomatibus simplicibus vel simplicibus et fasciculatis; gemmis nudis, dense pubescentibus; foliis oppositis, unifoliolatis; petiolo adaxialiter vadose caniculata, apice tumida; lamina pinnatinervis, integera, pellucido-punctata; inflorescentis axillaribus, anguste paniculatis vel racemosis; floribus unisexualibus, in alabastro globosis vel subglobosis; sepalis 4, basi connatis, valvatis, ovato-triangularibus, in fructu persistentibus; petalis 4, distinctis, erectis, patentibus, vel reflexis, anguste imbricatis, ovatis vel ovato-lanceolatis, apice acutis et adaxialiter minute uncinatis, in fructu deciduis; staminibus 8, distinctis, in fructu deciduis, alternatim inaequalibus, petala fere aequantibus, filamento glabro, sublineari, incurvato, apice subulato et minute geniculato, anthera ovoidea vel ellipsoidea, apiculata, dorsifixa, in floribus ♀ sine polline; disco intrastaminali, applanato vel pulvinato, irregulariter 8-lobato; gynoecio syncarpo, 4-carpellato, 4-loculato, in floribus ♀ petala fere aequanti, in floribus ♂ rudimentario, ovario subgloboso, plerumque vadose 4-lobato, placentatione axiali, ovulis in quoque loculo 2, collateralibus vel subcollateralibus, stylo recto, stigmate capitata, 4-lobata; fructibus drupaceis, syncarpis, 4-loculatis, exocarpio subcoriaceo, glanduloso-pustulato, mesocarpio spongioso, in sicco tenui vel obsoleto, endocarpio pergamentaceo, glabro, brunneo vel luteo, nitido; seminibus in quoque loculo 2 vel (abortibus) 1, ovoideis vel reniformibus, atrobrunneis vel nigeris, nitidis, testa exterior spongiosa (*Maclurodendron parviflorum* excepta), testa interior ossea; endospermio copioso, carnoso; embryone recto vel leviter flexo, elliptico vel late oblongo, cotyledonibus complanatis, hypocotylo terminali; fructibus et seminibus *M. magnificum* incognitis. Species typica: *M. porteri* (Hook. f.) Hartley.

Woody plants; apparently dioecious; indumentum brownish to rust coloured, trichomes simple or simple and fasciculate; buds naked, densely pubescent. Leaves opposite,

unifoliolate; petiole shallowly caniculate adaxially, swollen at the apex; blade pinnately veined, entire, with pellucid oil dots. Inflorescences axillary, narrowly paniculate or racemose. Flowers unisexual, globose or subglobose in bud; sepals 4, basally connate, valvate, ovate-triangular, persistent in fruit; petals 4, distinct, erect, spreading, or reflexed, narrowly imbricate, ovate to ovate-lanceolate, acute and minutely hooked adaxially at the apex, deciduous in fruit; stamens 8, distinct, deciduous in fruit, the antesepalous nearly as long as the petals, the antepetalous slightly shorter, filament glabrous, sublinear, curved inward, subulate and minutely geniculate at the apex, anther ovoid to ellipsoid, apiculate, dorsifixed, without pollen in carpellate flowers; disc intrastaminal, flattened to pulvinate, irregularly 8-lobed; gynoecium a single 4-carpellate, 4-loculate pistil, nearly as long as the petals in carpellate flowers, rudimentary in staminate flowers, ovary subglobose and usually shallowly 4-lobed, placentation axile, ovules 2 per carpel, collateral to subcollateral, style straight, stigma capitate, 4-lobed. Fruits drupaceous, syncarpous, 4-loculate, exocarp subleathery, pustular-glandular, mesocarp spongy, thin to obsolete when dry, endocarp pergamentaceous, glabrous, brown to yellow, shiny. Seeds 2 or (by abortion) 1 per locule, ovoid to reniform, dark brown to black, shiny, outer testa spongy (except in *Maclurodendron parviflorum*), inner testa bony; endosperm copious, fleshy; embryo straight or slightly bent, elliptic to broadly oblong, cotyledons flattened, hypocotyl terminal. Fruits and seeds of *M. magnificum* unknown.

The name *Maclurodendron* commemorates Floyd A. McClure (1897–1970), well known for his extensive studies of the bamboos, and for his plant explorations in Southeast Asia. One of his collections from Hainan Island is the type of *M. oligophlebium.*

All of the species of *Maclurodendron* appear to be dioecious; I have not found any single specimens bearing flowers of both sexes or both fruits and staminate flowers.

The inflorescences are borne singly in the axils of leaves. They may be associated with most, or all, of the leaves of a flowering branchlet, or they may be restricted to the upper leaves. Taxonomically, this variability seems to be of no significance.

The inflorescences are usually pedunculate, but occasionally a single branch is developed at the base. Above the peduncle, the inflorescence is generally narrowly paniculate, with one or two lower pairs of branches above which the flowers are borne on pedicels attached directly to the main axis. The branches may be absent, however, and in such instances the inflorescences are racemose. This reduction in complexity of the inflorescence is irregular in occurrence and apparently has no taxonomic significance.

The rudimentary pistil of staminate flowers is generally minute, and its ovules, style, and stigma are not fully differentiated.

The pericarp is quite thin in all of the species and is sometimes split loculicidally in herbarium specimens of *Maclurodendron oligophlebium.* The split is apical and often irregular, and only occurs in one, or sometimes two, of the locules. It seems most likely that it is caused by pressing and drying the specimen; none of the collectors has noted its occurrence in fresh material.

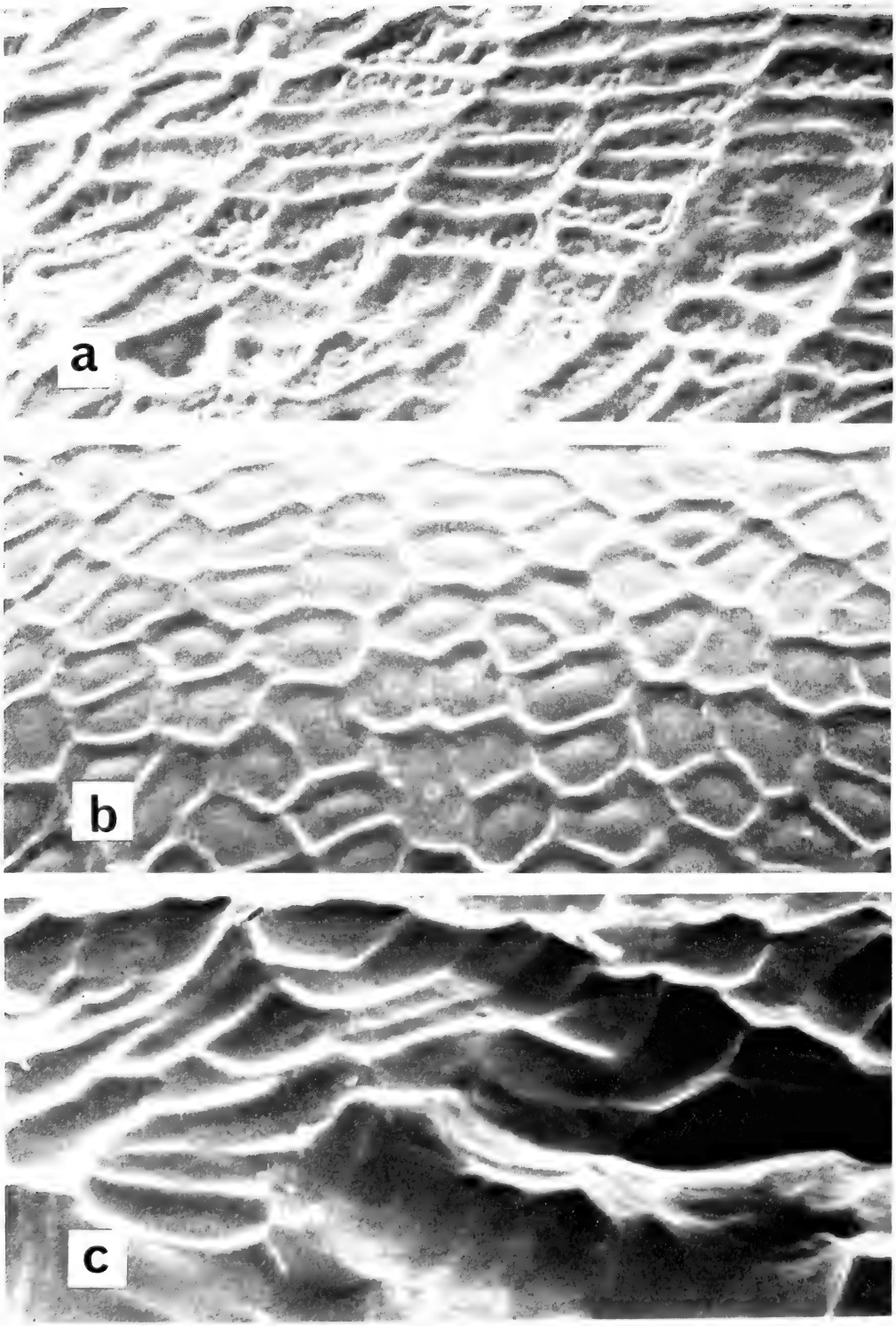


Plate 1. Scanning electron micrographs of seed coat sculpturing in *Maclurodendron* species: a, *M. porteri* (from *Ng FRI 1171*), showing irregularly reticulate surface; b, *M. obovatum* (from *Ramos & Convocar BS 83927*), showing regularly reticulate surface; c, *M. parviflorum* (from *Anderson S 25426*), showing irregularly roughened surface; all X 420.

The seeds vary considerably in shape depending on whether one or two develop in a locule. When only one is developed, it is regularly ovoid or reniform and usually rather turgid. When two are developed they are often irregularly shaped as a result of crowding: most commonly they are flattened on one side or on a portion of one side due to collateral or subcollateral crowding, but in some specimens of *Maclurodendron porteri* they are obliquely truncated as a result of being somewhat superposed in the locule.

Characteristics of the testa provide a basis for grouping the species (except for *Maclurodendron magnificum*, where the seeds are not known). This classification is given below.

Outline of species relationships

Outer testa consisting of a spongy layer bounded externally by a shiny pellicle, the surface reticulate*.

Surface of testa irregularly reticulate (see Pl. 1, a).

. . . . . 1. *M. porteri*

. . . . . 2. *M. pubescens*

Surface of testa regularly reticulate (see Pl. 1, b).

. . . . . 3. *M. obovatum*

. . . . . 4. *M. oligophlebium*

Outer testa consisting only of a shiny pellicle, the spongy layer obsolete, the surface irregularly roughened (see Pl. 1, c) . . . . . 5. *M. parviflorum*

Seeds not known . . . . . 6. *M. magnificum*

Key to the species

1. Indumentum predominantly of spreading trichomes; mature leaf blades pubescent below, especially on the midrib and main veins . . . . . 2. *M. pubescens*

1. Indumentum predominantly of ascending (often appressed-ascending) trichomes; mature leaf blades glabrous or nearly so

   2. Flower buds 2.5 – 3mm wide; sepals and petals densely pubescent abaxially . . . . . 6. *M. magnificum*

   2. Flower buds 1 – 2mm wide; sepals and petals glabrous to rather densely pubescent abaxially

---

* It is important to examine ripe seeds to determine sculpturing characteristics of the testa accurately.

3. Sepals at least half as long as the petals; petals about 1.5 mm long; seeds irregularly and longitudinally roughened (see Pl. 1, c) . . 5. *M. parviflorum*

3. Sepals less than half as long as the petals; petals 2 – 3 mm long; seeds minutely reticulate at 20X (see Pl. 1, a, b), at least over part of the surface

4. Leaf blades subcoriaceous to coriaceous, the secondary veins and reticulations prominent, especially above; seeds regularly reticulate . . . . . 3. *M. obovatum*

4. Leaf blades chartaceous to subcoriaceous, the secondary veins and reticulations not very prominent; seeds regularly or irregularly reticulate

5. Younger branchlets reddish; seeds collateral, regularly reticulate . . 4. *M. oligophlebium*

5. Younger branchlets pale brown to dark brown; seeds subcollateral or subsuperposed, irregularly reticulate . . . . . 1. *M. porteri*

1. *Maclurodendron porteri* (Hook. f.) Hartley, **comb. nov.** (Fig. 2).

Acronychia porteri Hook. f. Fl. Brit. India 1 (1875) 498. Lectotype (chosen here): *Maingay Kew Distribution No. 280,* W. Malaysia, Penang, Government Hill.

Melicope? helferi Hook. f. *ibid.* 492. Type: *Herb. Helfer 1192,* Burma, Tenasserim.

Jambolifera porteri (Hook. f.) O. Kuntze, Rev. Gen. Pl. 1 (1891) 102.

Melicope unifoliolata Merr. Philipp. J. Sci. Bot. 13 (1918) 74. Type: *Hose 556,* E. Malaysia, Sarawak, Miri River.

Small to medium tree to 25 m high; trichomes simple, or, in several Borneo collections, simple and fasciculate, predominantly ascending; innovations finely pubescent or puberulent; branchlets pale brown to dark brown, glabrous or nearly so, 2 – 6 mm wide. Leaves 6.5 – 29 cm long; petiole finely pubescent, especially adaxially, soon becoming glabrous, 0.7 – 3 (– 5) cm long; blade subcoriaceous or occasionally chartaceous, drying pale brown to dark brown to brownish green, glabrous or nearly so, obovate to oblanceolate or occasionally elliptic, 5.5 – 24 cm long, 1.8 – 10 cm wide, base cuneate or occasionally acute or attenuate, apex acuminate (the acumen 2 – 20 mm long) or occasionally acute, obtuse, rounded, or retuse, main veins 6 to 11 on each side of the midrib, secondary veins and reticulations not prominent. Inflorescences 2 – 15 cm long; peduncle, axis, branches, and pedicels minutely pubescent, soon becoming glabrous or nearly so;

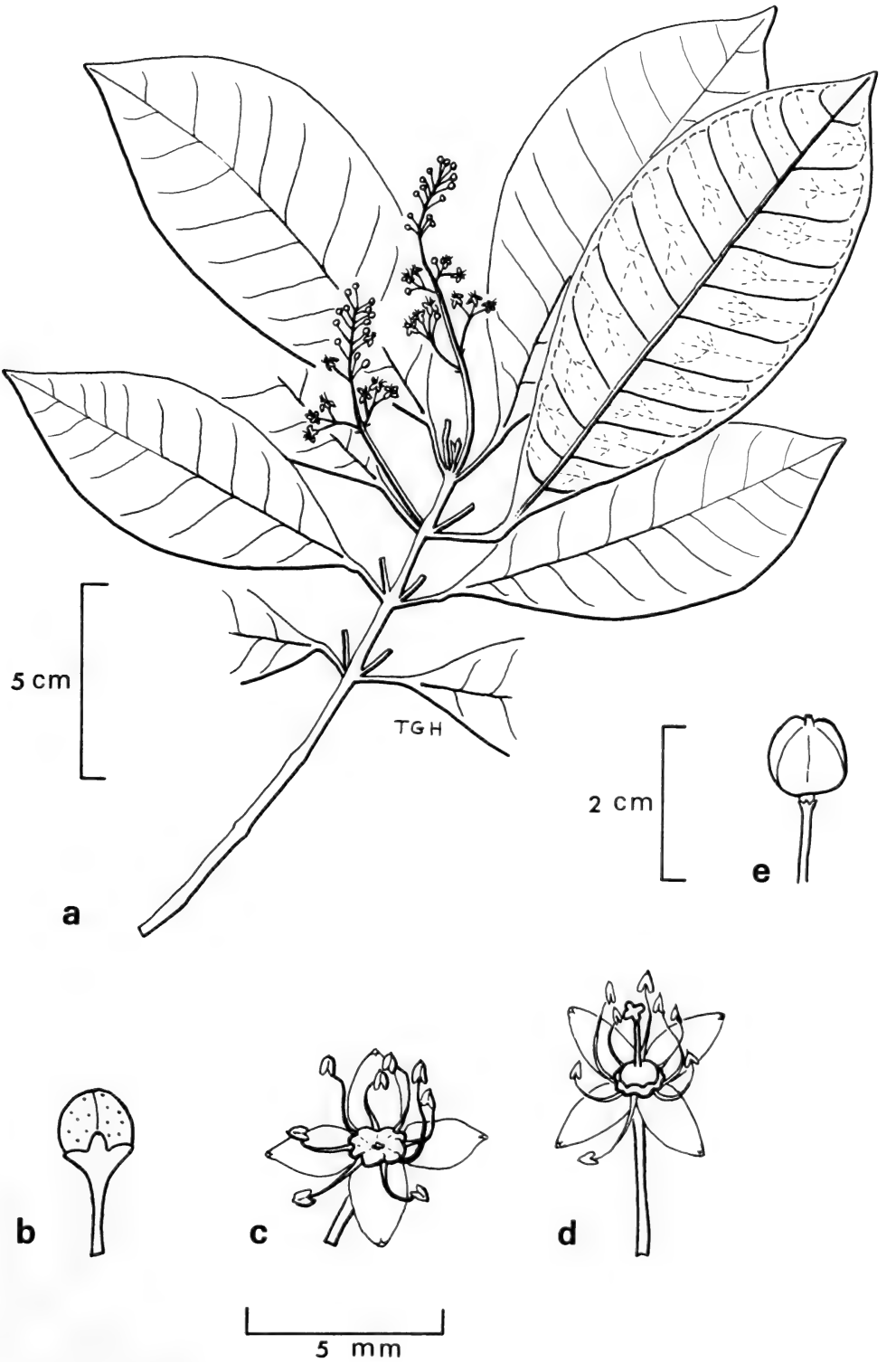


Fig. 2. *Maclurodendron porteri:* a, flowering branchlet; b, flower bud; c, staminate flower; d, carpellate flower; e, fruit (a-c drawn from *Ridley 3639a,* d from *Cockburn FRI 7835,* e from *Ng FRI 1171*).

pedicels 1 – 6 (– 7.5) mm long. Flowers green to yellow to white, in bud 1.5 – 2 mm wide; sepals glabrous or sparsely to rather densely pubescent, 0.5 – 1 mm long; petals glabrous or sparsely to rather densely pubescent abaxially, sparsely to densely pubescent or rarely glabrous adaxially, 2 – 2.5 mm long; anthers 0.6 – 0.8 mm long; disc glabrous, 1 – 1.5 mm wide; gynoecium glabrous, ovules subcollateral. Fruits glabrous, ovoid to subglobose or occasionally ellipsoid, often shallowly 4-lobed, often apiculate, (6 –) 8 – 11 mm wide. Seeds usually 2 per locule, subcollateral to subsuperposed, minutely and irregularly reticulate, often smooth over part of the surface, 4.5 – 8 mm long, outer testa spongy.

Distribution. Malay Peninsula and Sumatra east to the Philippines (Fig. 1); recorded mainly from well-drained, primary rain forests; occasionally from secondary forests and (a few Sarawak collections) heath forests; sea level to 900 (– 1500) m.

PENINSULAR BURMA. District Mergui: Pataw Island, *Parker 2768* (DD, K); Sarawa River, *Parker 2488* (DD, K). Without definite locality, *Herb. Helfer 1192* (K, holotype of *Melicope helferi* Hook. f.; GH, isotype), *Herb. Griffith 1189* (GH, L, W).

PENINSULAR THAILAND. Ranong, *Kerr 11767* (L), *16361* (BM, K), *17015* (BM, K, P); Ban Pang Wan, *Kerr 11953* (BM); Pang Nga, *Kerr 17171* (BM, P); Krabi, *Kerr 18603* (A, BM, K, L, P); without definite locality, *Kloss 7009* (K).

W. MALAYSIA. Kedah: Koh Mai Forest Reserve, *Kiah SF 35204* (K); Bukit Enggang Road, *Everett FRI 13746* (K, L); Jeniang Road, 48th mile, *Kiah SF 36165* (A). Penang: Government Hill, *Maingay Kew Distribution No. 280* (K, lectotype of *Acronychia porteri* Hook. f.; BM, GH, L, duplicates of lectotype), *Ridley,* March 1915 (BM); without definite locality, *Curtis 3089* (K), *Porter [Wallich Catalog No. 7756]* (BM, K). Kelantan: Kampong Gobik, Kerilla Estate, Tamangan, *Shah & Kadim 486* (A, K, L, LAE); Gunong Strong, *Whitmore FRI 12504* (K); Gua Musang, *Whitmore FRI 4020* (K, L); Gunong Rabong, *Soepadmo & Mahmud 1147* (L). Trengganu: Bukit Bauk Forest Reserve, *Whitmore FRI 3955* (K, L), *Wood KEP 76090* (L). Perak: Larut, *King's Collector 3979* (US), *4482* (K, US, W), *7469* (A, U); Gunong Bubu, *Everett FRI 13951* (K, L), *King's Collector 8338* (UC), *Suppiah FRI 11944* (L); Piah Forest Reserve, *Kochummen FRI 2422* (K, L); without definite locality, *Scortechini 11801* (BM, L). Pahang: Kuantan District, *Yeob CF 834* (K); Tasek Bera, *Soepadmo et al. KLU 11742* (BISH, L). Selangor: Genting Simpah Road, 17th mile, *Kochummen FRI 2054* (K, L); Weld Hill Forest Reserve, *Kochummen KEP 99520* (A, K, L); without definite locality, *Murdoch 154* (BM). Negri Sembilan: Galah Forest Reserve, *Ng FRI 1884* (L). Malacca: Tampin Hill, *Goodenough 1851* (NSW); Batang Malacca, *Derry 1043* (K, NSW); Ayer Panas Forest Reserve, *Ng FRI 1171* (L); without definite locality, *Derry 1162* (K), *Griffith* (BM, K, L). Johore: Segamat Forest Reserve, *Loh FRI 17130* (L); Sungai Peta near Kampong Tenang, Labis, *Heaslett,* 27 June 1971 (L); Sungai Kayu, *Kiah SF 32375* (A, LAE), *SF 32420* (LAE); Gunong Panti Forest Reserve, *Cockburn FRI 7742* (L), *FRI 7835* (L); Tanjong Sedili Kechil, *Cockburn FRI 7684* (K, L).

SINGAPORE. MacRitchie Reservoir, *Sinclair,* 26 Dec. 1948 (L), 16 Jan. 1949 (L); Bukit Timah, *Ridley,* Feb. 1900 (NSW); without definite locality, *Ridley 3467* (BM, K), *3639a* (NSW), *4741* BM, NSW), *5587* (BM).

SUMATRA. Asahan: Hoeta Padang, *Krukoff 4323* (A, L, NY, SING, US); Bandar Poelau, *Yates 2571* (MICH, NY, W); Loemban Ria vicinity, *Rahmat si Boeea 7975* (A, BISH, MICH, UC, US). Palembang: Tanjong Ring, *Forbes 2726* (BM, GH, K, L), *2832a* (BM, GH, K, L); Niroe River, *de Voogd 211* (L); Lematang River, *Anonymous Boschproefstation 103 T-3 P 272* (L), *Boschproefstation T [Thorenaar] 845* (L); Muara Enim, *Kostermans,* 2 Feb. 1956 (A, BISH, BM, CANB, L, LAE, NY, P). Lingga Archipelago: Lingga Island, Gunong Tanda, *Anonymous [Teysmann HB?] 14620* (L); Medang Island, *Anonymous HB 4004* (L, U). Bangka: Bangka Island, Gunong Mangol, *Kostermans & Anta 671* (A, L), *693* (A, K, L, LAE). *793* (A, L, LAE, NSW); Bangka Island, Lobok Besar, *Kostermans bb 34060* (A, L), *bb 34134* (A, L), *bb 34138* (L), *Kostermans & Anta 190* (L), *1067* (A, BO, L, SING); Lepar Island, *Bünnemeijer 2436* (L).

E. MALAYSIA. Sarawak. 1st Division: Gunong Pueh, *Ilias Paie S 13716* (K, L); Gunong Gading, *Ilias Paie S 13332* (L, SING); Semengoh Forest Reserve, *Bojeng bin Sitam S 14639* (A, L, MEL, SING), *Galau S 15644* (A, L), *Haji Bujang Tree No. 3926* (L), *Sibat ak Luang S 13960* (A, L, P); Kuching and vicinity, *Haviland 2257* (K, L), *2282* (K, L), *2846* (K). 3rd Division: Bukit Raya, *Smith & Chai S 27649* (L). 4th Division: Bukit Mayeng, *Purseglove 5370* (A, L, NY); Bukit Mersing, *Sibat ak Luang S 21938* (L, SING), *S 21984* (L); Miri River, *Hose 539* (K, L), *556* (K, L, isotypes of *Melicope unifoliolata* Merr.); Usun Apau Plateau, *Haji Suib S 23428* (A, L), *Murthy & Ashton S 22677* (A, K, L), *Pickles S 3914* (L, US), *S 3935* (L, US), *Sibat ak Luang S 22991* (A, L). Without definite locality, *Beccarri [PB] 3500* (K, P). Sabah. Beaufort District: Beaufort Hill, *Binideh [SAN] 55734* (L), *Mikil [SAN] 30331* (L), *Sadau [SAN] 42569* (K), *[SAN] 49548* (K, L); Lumat, *Buntar SAN 25805* (L). Tomani District: Kuala Tomani, *Binideh [SAN] 63165* (L). Ranau District: Kinabalu National Park, Bukit Kolong Ranau, *Gibot SAN 60674* (L). Beluran District: Sungai Sapi, K. B. Dev. Camp, *Tingguan SAN 36336* (K, L). Tawau District: Kalabakan, *Baker SAN 25017* (L); Quoin Hill Road, Mile 15, *Gibot SAN 31256* (SING), *[SAN] 34008* (K, L); Apas Road, Mile 15, *Jaswir Singh SAN 29961* (L). Lahad Datu District: Silam Quarry Hill, *Muin Chai SAN 25571* (L).

BRUNEI. Belait District, R. Belait at K. Ingei, *Ashton BRUN 199* (BO); Temburong District, Kuala Belalong, *Smythies, Wood & Ashton SAN 17077* (A, L).

KALIMANTAN. Kalimantan Tengah: Mt. Palimasan on Belajan River, *Kostermans 13013* (CANB, L); Nunukan Island, *Kostermans 9186* (A, L, SING), *9219* (A, BO, L), *Paijmans 105* (L), *158* (L).

PHILIPPINES. Luzon: Quezon Province, Tayabas, *Oro FB 31048* (NY); Camarines Sur Province, Mt. Madooy, *Edaño BS 76064* (A, K, MICH, NY).

Hooker based *Acronychia porteri* on three syntype collections, *Porter [Wallich Catalog No. 7756]* and *Maingay Kew Distribution No. 280,* both from Penang, and *Griffith s.n.*, from Malacca. The Kew sheet of the Maingay collection is chosen here as the lectotype.

The type collection of *Melicope? helferi* Hook. f., *Herb. Helfer 1192* (from Peninsular Burma), which consists of staminate flowering branchlets, is without doubt conspecific with the syntype collections of *Acronychia porteri* Hook. f. It is surprising that Hooker misplaced it in *Melicope* because the latter collections also include specimens with staminate flowers.

The type collection of *Melicope unifoliolata* Merr., *Hose 556,* from Sarawak, also consists only of staminate flowering branchlets, which probably explains its generic misplacement. Merrill noted that it was "manifestly allied" to *Melicope helferi* Hook. f.

As pointed out in the Outline of Species Relationships, *Maclurodendron porteri* appears to be most closely related to *M. pubescens.* The differences between the two species are mainly those of indumentum given in the Key to Species.

2. *Maclurodendron pubescens* Hartley, **sp. nov.**

Arbor parva vel mediocris usque 24 m alta; trichomatibus simplicibus et fasciculatis, pro parte maxima patentibus; innovationibus pubescentibus; ramulis cinereis vel pallido-brunneis vel atro-brunneis, pubescentibus, mox glabratis, 4 – 8 mm latis; foliis 13 – 28 cm longis; petiolo dense pubescenti, mox glabratis, 1.5 – 5 cm longo; lamina subcoriacea, in sicco pallido-viridulo-brunneis vel brunneis, subtus (praecipue in costa et venis) pubescenti, supra glabra, obovata vel oblanceolata vel (in foliis infrequentibus) elliptica, 11 – 23 cm longa, 4.8 – 10.5 cm lata, basi cuneata vel attenuata, apice acuminata (acumine 5 – 10 mm longo) vel rotundata vel retusa, venis primariis utrinsecus costae

8 – 11, venis secondariis et rete venularum non prominentibus; inflorescentiis 3 – 11 cm longis, pedunculo sparse vel dense pubescenti, postremo glabrato, rhachidi et ramis sparse vel dense pubescentibus, pedicellis dense pubescentibus, 3.5 – 5 mm longis; floribus viridibus, in alabastro 1.5 – 2 mm latis; sepalis pubescentibus, ca 0.8 mm longis; petalis abaxialiter pubescentibus, adaxialiter sparse pubescentibus vel fere glabris, 2 – 2.5 mm longis; antheris 0.5 – 0.7 mm longis; disco glabro, 1.5 – 1.8 mm lato; gynoecio rudimentario glabro, ovulis rudimentariis subcollateralibus; fructibus glabris, ovoideis vel subglobosis, 10 – 12 mm latis, vadose 4-lobatis, apice plerumque acutis; seminibus in quoque loculo plerumque 2, subcollateralibus, minute et irregulariter reticulatis, saepe partim laevibus, 5 – 7 mm longis, testa exterior spongiosa; floribus ♀ non visi. Holotypus: *Patrick P. Sam SAN 26359* (L).

Small to medium tree to 24 m high; trichomes simple and fasciculate, predominantly spreading; innovations pubescent; branchlets grey to pale brown to dark brown, pubescent, soon becoming glabrous, 4 – 8 mm wide. Leaves 13 – 28 cm long; petiole densely pubescent, soon becoming glabrous, 1.5 – 5 cm long; blade subcoriaceous, drying pale greenish brown to brown, pubescent below mainly on the midrib and veins, glabrous above, obovate to oblanceolate or (in occasional leaves) elliptic, 11 – 23 cm long, 4.8 – 10.5 cm wide, base cuneate to attenuate, apex acuminate (the acumen 5 – 10 mm long) to rounded or retuse, main veins 8 to 11 on each side of the midrib, secondary veins and reticulations not prominent. Inflorescences 3 – 11 cm long; peduncle sparsely to densely pubescent, finally becoming glabrous or nearly so; axis and branches sparsely to densely pubescent; pedicels densely pubescent, 3.5 – 5 mm long. Flowers green, in bud 1.5 – 2 mm wide; sepals pubescent, about 0.7 mm long; petals pubescent abaxially, sparsely pubescent to nearly glabrous adaxially, 2 – 2.5 mm long; anthers 0.5 – 0.7 mm long; disc glabrous, 1.5 – 1.8 mm wide; rudimentary gynoecium glabrous, rudimentary ovules subcollateral. Fruits glabrous, ovoid to subglobose, 10 – 12 mm wide, shallowly 4-lobed, usually acute at the apex. Seeds usually 2 per locule, subcollateral, minutely and irregularly reticulate, often smooth over part of the surface, 5 – 7 mm long, outer testa spongy. Carpellate flowers not seen.

Distribution. E. Malaysia, Sabah (Fig. 1); recorded from well-drained, primary forests; sea level to 130 m.

E. MALAYSIA. Sabah. Sandakan: Sepilok Forest Reserve, *Ampon & Patrick SAN 71519* (L), *Anonymous [G. H. S. Wood?] SAN A 3892* (A, L), *Meijer SAN 21746* (BO, L), *Meijer & Stone SAN 58909* (K, L), *Nicholson & Patrick P. Sam SAN 15404* (L), *SAN 17046* (L, SING), *Toipin SAN 40708* (K, L), *Wood SAN 16033* (A, BRI); Mt. Walker, *Madani SAN 44256* (K); Kobili Bukit, *Kadir [SAN] A 680* (CANB, US); Leila Forest Reserve, *Patrick P. Sam SAN 20650a* (L), *SAN 26359* (L, holotype; K, isotype), *SAN 26377* (L). Lamag District: Bilit, *Banang SAN 51928* (K, L).

As noted above, this species is probably most closely related to ***Maclurodendron porteri.***

3. *Maclurodendron obovatum* (Merr.) Hartley, **comb. nov.**

Acronychia obovata Merr. Philipp. J. Sci. Bot. 12 (1917) 274. Type: ***Mallonga FB 26473,*** Philippines, Mindanao, Surigao Province, Manangas, Carrascal.

Small to medium tree to 13 m high; trichomes simple and fasciculate, predominantly ascending; innovations pubescent; branchlets pale brown to brownish red to blackish, pubescent, soon becoming glabrous, 5 – 6 mm wide. Leaves 9 – 21.5 cm long; petiole

pubescent, especially adaxially, finally becoming glabrous or nearly so, 1.4 – 3 cm long; blade subcoriaceous to coriaceous, drying greenish brown to brown, usually pubescent below on the midrib, soon becoming glabrous, glabrous above, obovate or occasionally broadly oblanceolate, 7.5 – 18 cm long, 4.7 – 9 cm wide, base obtuse to cuneate, apex acuminate (the acumen 3 – 7 mm long), rounded, or subtruncate, main veins 9 to 14 on each side of the midrib, secondary veins and reticulations prominent, especially above. Inflorescences 3 – 10 cm long, peduncle, axis, branches, and pedicels sparsely pubescent, soon becoming glabrous or nearly so; pedicels 5 – 6 mm long. Flowers pale green, in bud 1.5 – 2 mm wide; sepals glabrate, about 0.7 mm long; petals glabrous abaxially, glabrous or nearly so adaxially, about 2.5 mm long; anthers 0.5 – 0.8 mm long; disc glabrous, 1.4 – 1.5 mm wide; gynoecium glabrous, ovules subcollateral. Fruits glabrous, globose or subglobose, often apiculate, 8 – 10 mm wide. Seeds 1 or 2 per locule, subcollateral or subsuperposed, minutely and regularly reticulate, often smooth over part of the surface, about 5 mm long, outer testa spongy.

Distribution. Philippines, northeastern Mindanao and nearby Bucas Grande and Dinagat Islands (Fig. 1); recorded from well-drained forests; low to middle altitudes.

PHILIPPINES. Mindanao. Surigao del Norte: Dinagat Island, *Ramos & Convocar BS 83811* (NY), *BS 83927* (NY), *Ramos & Pascasio BS 35184* (GH, NSW), *BS 35193* (A, BM, K, US); Bucas Grande Island, *Ramos & Pascasio BS 35058* (A, US). Surigao del Sur: Manangas, Carrascal, *Mallonga FB 26473* (US, isotype of *Acronychia obovata* Merr.); without definite locality, *Ramos & Pascasio BS 34681* (L).

As noted in the Outline of Species Relationships, this species appears to be most closely related to *Maclurodendron oligophlebium*. The main differences between the two species are in the texture of the leaf blade and the comparative prominence of the secondary veins and reticulations (see Key to Species) and in the arrangement of the ovules and seeds (subcollateral in *M. obovatum* vs. collateral in *M. oligophlebium*).

4. *Maclurodendron oligophlebium* (Merr.) Hartley, **comb. nov.**

Acronychia oligophlebia Merr. Philipp. J. Sci. 23 (1923) 246. Type: *McClure CCC 9496*, China, Hainan Island, Five Finger Mt.

Small to medium tree to 13 (– 25) m high; trichomes simple, predominantly ascending; innovations finely pubescent to puberulent; branchlets reddish, becoming grey-brown, glabrous or nearly so, 3 – 6 mm wide. Leaves 6.5 – 23.5 cm long; petiole finely pubescent to puberulent, especially adaxially, soon becoming glabrous, 0.8 – 2.5 cm long; blade chartaceous to subcoriaceous, drying brown or brownish green, glabrous or nearly so, obovate to oblanceolate or occasionally elliptic, 6 – 21.5 cm long, 2.5 – 8.2 cm wide, base cuneate to attenuate, apex acuminate (the acumen 5 – 10 mm long) or occasionally obtuse or rounded, main veins 6 to 10 on each side of the midrib, secondary veins and reticulations not very prominent. Inflorescences 3.5 – 10 cm long; peduncle, axis, and branches minutely pubescent, soon becoming glabrous or nearly so; pedicels minutely pubescent, 1.5 – 5 mm long. Flowers green, yellowish green, or white, in bud about 2 mm wide; sepals finely pubescent, 0.6 – 0.7 mm long; petals sparsely pubescent to glabrate abaxially, sparsely pubescent adaxially, 2.5 – 3 mm long; anthers 0.8 – 1 mm long; disc glabrous, 1.3 – 1.6 mm wide; gynoecium glabrous, ovules collateral. Fruits glabrous, globose or subglobose, often shallowly 4-lobed, often apiculate, 6 – 10 mm

wide. Seeds usually 2 per locule, collateral, minutely and regularly reticulate, often smooth over part of the surface, 4.5 – 5.5 mm long, outer testa spongy.

Distribution. Hainan Island and Vietnam (Fig. 1); recorded from well-drained forests; 200 – 1200 m.

Illustration. C. C. Huang, *Acta Phytotax. Sinica* 7 (1958) *t. 66, fig. 1* (as *Acronychia oligophlebia*).

CHINA. Hainan Island: Ching Mai District, Pak Shik Ling vicinity, *Lei 543* (K, NY, UC, US, W), *851* (A, NY, UC, US, W); Dung Ka to We Fa Shi, *Chun & Tso 43753* (A, BISH, NY, W); Kan-en District, Chim Fung Ling, *Lau 3716* (A, BISH, P); Five Finger Mt., *Chun 1490* (UC), *McClure CCC 9496* (A, BISH, BM, K, P, UC, isotypes of *Acronychia oligophlebia* Merr.); Pao-ting, *How 72159* (A, P); Yaichow, *How 70313* (NY), *Liang 62369* (NY, US), *62465* (NY); Nagai District, Yeung Ling Shan, *Lau 51* (BM, MICH, NY, UC, US, W): Mo San Leng, *Chun & Tso 44291* (A, K, NY, US); without definite locality, *Liang 64191* (A, NY), *64246* (NY), *65061* (NY, US), *65179* (A, NY, UC), *Wang 34303* (A, NY).

VIETNAM, Quangtri Province: Massif de Dong Cho, *Poilane 11123* (P), *11195* (P), *11242* (P); Dent du Tigre, *Poilane 10287* (P), *10300* (P). Quangnam Province: Montagne de Ba Na, *Poilane 1498* (P); Col des Nuages pres de Tourane [Da Nang], *Poilane 7957* (P), *8025* (P), *8037* (P).

This species is apparently most closely related to *Maclurodendron obovatum* (see under that species).

5. *Maclurodendron parviflorum* Hartley, **sp. nov.**

Arbor parva usque ca 4.5 m alta; trichomatibus simplicibus, pro parte maxima ascendentibus; innovationibus puberulis; ramulis pallido-brunneis vel atro-brunneis, glabratis, ca 3 mm latis; foliis 10.5 – 19 cm longis; petiolo adaxialiter puberulo, mox glabrato, 1 – 2 cm longo; lamina subcoriacea, in sicco pallido-viridi, glabra vel fere glabra, elliptica vel (in foliis infrequentibus) obovata vel oblanceolata, 9 – 16.5 cm longa, 3 – 9 cm lata, basi cuneata, apice acuminata (acumine 5 – 10 mm longo) vel interdum obtusa vel retusa, venis primariis utrinsecus costae 7 – 11, venis secondariis et rete venularum non prominentibus; inflorescentiis 1 – 3 cm longis, pedunculo, rhachidi, et ramis puberulis, mox glabratis, pedicellis sparse puberulis, 1 – 3 mm longis; floribus pallido-viridibus vel pallido-luteis, in alabastro 1 – 1.5 mm latis; sepalis sparse puberulis, 0.7 – 1 mm longis; petalis glabris, ca 1.5 mm longis; antheris 0.4 – 0.5 mm longis; disco glabro, 0.6 – 1 mm lato; gynoecio glabro, ovulis subcollateralibus; fructibus glabris, ovoideis vel subglobosis, ca 7 mm latis, vadose 4-lobatis, apice acutis; seminibus in quoque loculo 1 vel 2, subcollateralibus, irregulariter et longitudinaliter rugosis, ca 5 mm longis, testa exterior non spongiosa. Typus: *J. A. R. Anderson S 25426* (L).

Small tree to about 4.5 m high; trichomes simple, predominantly ascending; innovations puberulent, branchlets pale brown to dark brown, glabrous or nearly so, about 3 mm wide. Leaves 10.5 – 19 cm long; petiole puberulent adaxially, soon becoming glabrous, 1 – 2 cm long; blade subcoriaceous, drying pale green, glabrous or nearly so, elliptic or (in occasional leaves) obovate or oblanceolate, 9 – 16.5 cm long, 3 – 9 cm wide, base cuneate, apex acuminate (the acumen 5 – 10 mm long) or occasionally obtuse or retuse, main veins 7 to 11 on each side of the midrib, secondary veins and reticulations not prominent. Inflorescences 1 – 3 cm long; peduncle, axis, and branches puberulent, soon becoming glabrous or nearly so; pedicels sparsely puberulent, 1 – 3 mm long. Flowers pale green or pale yellow, in bud 1 – 1.5 mm wide; sepals sparsely puberulent, 0.7 – 1 mm long; petals glabrous, about 1.5 mm long; anthers 0.4 – 0.5 mm long; disc

glabrous, 0.6 – 1 mm wide; gynoecium glabrous, ovules subcollateral. Fruits glabrous, ovoid to subglobose, about 7 mm wide, shallowly 4-lobed, acute at the apex. Seeds 1 or 2 per locule, subcollateral, irregularly and longitudinally roughened, about 5 mm long, outer testa not spongy.

Distribution. E. Malaysia, Sarawak, vicinity of Kuching (Fig. 1); recorded from primary heath forest and secondary forest on podzolized soil; rather low elevation.

E. MALAYSIA. Sarawak. 1st Division: near Kuching, *Haviland 1986* (K); Stampin, 7 km south of Kuching, *Anderson S 25126* (L); vicinity of Kuching, Batu Kawa Road, 3½ Mile, *Anderson S 25426* (L, holotype).

As noted in the Outline of Species Relationships, of the five species for which seeds are known, this is the only one lacking spongy tissue in the outer testa. A spongy outer testa is apparently vestigial in indehiscent-fruited Rutaceae (see Hartley, in press) and therefore this may by, with regard to testa structure, the most highly derived species of the genus.

Besides the different structure of its testa, *Maclurodendron parviflorum* is distinguishable from the other species of the genus by its smaller flowers with sepals at least half as long (as opposed to less than half as long) as the petals.

6. *Maclurodendron magnificum* Hartley, **sp. nov.**

Acronychia sp. nov. (*"magnifica"* nom. prov.), B. C. Stone, Malaysian Forester 43 (1980) 252, *fig. 3.*

Arbor 4.5 m alta; trichomatibus simplicibus et fasciculatis, pro parte maxima ascendentibus; innovationibus subtiliter pubescentibus; ramulis cinereo-brunneis, subtiliter pubescentibus, mox glabratis, 6 – 7 mm latis; foliis 15 – 20 cm longis; petiolo praecipue adaxialiter pubescenti, postremo glabrato, 1.3 – 2 cm longo; lamina subcoriacea, in sicco viridi, subtus sparse pubescenti (praecipue in costa), mox glabrata, supra glabra, elliptica, 12.5 – 18.5 cm longa, 6.7 – 9.2 cm lata, basi acuta vel cuneata, apice acuminata (acumine 3 – 5 mm longo), venis primariis utrinsecus costae 11, venis secundariis et rete venularum non prominentibus; inflorescentiis ante anthesin ca 4.5 cm longis, pedunculo glabrato, rhachidi, ramis, et pedicellis dense pubescentibus, pedicellis 2 – 3 mm longis; floribus (alabastris ♂ solis visis) viridulis, in alabastro 2.5 – 3 mm latis; sepalis dense pubescentibus, ca 1.5 mm longis; petalis abaxialiter dense pubescentibus, adaxialiter sparse pubescentibus; antheris ca 1 mm longis; disco glabro, ca 1.2 mm lato; gynoecio rudimentario glabro, ovulis rudimentariis subcollateralibus; floribus ♀ et fructibus non visis. Holotypus: *Stone 8905* (L).

Tree 4.5 m high; trichomes simple and fasciculate, predominantly ascending; innovations finely pubescent; branchlets grey-brown, finely pubescent, soon becoming glabrous, 6 – 7 mm wide. Leaves 15 – 20 cm long; petiole pubescent, especially adaxially, finally becoming glabrous, 1.3 – 2 cm long; blade subcoriaceous, drying green, sparsely pubescent below mainly on the midrib, soon becoming glabrous, glabrous above, elliptic, 12.5 – 18.5 cm long, 6.7 – 9.2 cm wide, base acute to cuneate, apex acuminate (the acumen 3 – 5 mm long), main veins 11 on each side of the midrib, secondary veins and reticulations not prominent. Inflorescences prior to anthesis about 4.5 cm long; peduncle glabrate; axis, branches, and pedicels densely pubescent; pedicels 2 – 3 mm long. Flowers

(only staminate buds seen) greenish, in bud 2.5 – 3 mm wide; sepals densely pubescent, about 1.5 mm long; petals densely pubescent abaxially, sparsely pubescent adaxially; anthers about 1 mm long; disc glabrous, about 1.2 mm wide; rudimentary gynoecium glabrous, rudimentary ovules subcollateral. Carpellate flowers and fruits not seen.

Distribution. Known only from the type locality (Fig. 1).

W. MALAYSIA. Pahang: summit area of Gunong Ulu Kali, *Stone 8905* (L, holotype).

According to Stone (1980 and in litt.), the following additional collections from Gunong Ulu Kali represent this species: eastern slope at 1500 m, *Stone 13904* (KLU); *Stone s. n.* 16 Sept. 1979 (KLU); *Stone 15088* (KLU).

Although the material I have seen (a single collection in late flower bud) is incomplete, I am confident that its identity is correct. It stands apart from the other species of the genus in having larger, more densely pubescent flower buds (as illustrated by Stone, 1980).

Benjamin Stone has recognised this plant as a novelty as far back as 1971, and on several subsequent trips to Gunong Ulu Kali has been unsuccessful in his search for fruiting specimens. He writes *(in litt.)* that in the past few years the vegetation of the summit area of Gunong Ulu Kali has been disturbed by commercial development, so the future of the species may be precarious.

Acknowledgements

I wish to thank the directors and curators of the herbaria listed on page 4 for making specimens in their care available to me. Thanks are also extended to Mike Moncur, C.S.I.R.O. Division of Land Use Research, who did the scanning electron microscopy.

Literature cited

Hartley, T. G. (1974). A revision of the genus *Acronychia* (Rutaceae). J. Arnold Arb. 55: 469-523, 525-567.

. (in press). A revision of the genus *Sarcomelicope* (Rutaceae). Austral. J. Bot.

Stone, B. C. (1980). Additions to the Malayan flora, VIII. Malaysian Forester 43: 244-262.

Index to collections

The numbers in parentheses refer to the corresponding species in the text.

Ampon & Patrick *SAN 71519* (2).

Anderson *S 25126, S 25426* (5).

Anonymous *Boschproefstation 103 T-3 P 272, Boschproefstation T [Thorenaar] 845* (1); *[G. H. S. Wood?] SAN A 3892* (2); *HB 4004, [Teysmann HB?] 14620* (1).

Ashton *BRUN 199* (1).

Baker *SAN 25017* (1).

Banang *SAN 51928* (2).

Beccari *[PB] 3500* (1).

Binideh, P., *[SAN] 63165* (1).

Binideh, R., *[SAN] 55734* (1).

Bojeng bin Sitam *S 14639* (1).

Bunnemeijer *2436* (1).

Buntar *SAN 25805* (1).

Chun, N. K., & Tso *43753, 44291* (4).

Chun, W. Y., *1490* (4).

Cockburn *FRI 7684, FRI 7742, FRI 7835* (1).

Curtis *3089* (1).

Derry *1043, 1162* (1).

Edãno *BS 76064* (1).

Everett *FRI 13746, FRI 13951* (1).

Forbes *2726, 2832a* (1).

Galau *S 15644* (1).

Gibot *SAN 31256, [SAN] 34008, SAN 60674* (1).

Goodenough *1851* (1).

Haji Bujang *Tree No. 3926* (1).

Haji Suib *S 23428* (1).

Haviland *1986* (5); *2257, 2282, 2846* (1).

Herb. Griffith *1189* (1).

Herb. Helfer *1192* (1).

Hose *539, 556* (1).

How *70313, 72159* (4).

Ilias [bin] Paie *S 13332, S 13716* (1).

Kadir *[SAN] A 680* (2).

Kerr *11767, 11953, 16361, 17015, 17171, 18603* (1).

Kiah *SF 32375, SF 32420, SF 35204, SF 36165* (1).

King's Collector *3979, 4482, 7469, 8338* (1).

Kloss, C. B., *7009* (1).

Kochummen *FRI 2054, FRI 2422, KEP 99520* (1).

Kostermans *9186, 9219, 13013, bb 34060, bb 34134, bb 34138* (1).

Kostermans & Anta *190, 671, 693, 793, 1067* (1).

Krukoff *4323* (1).

Lau *51, 3716* (4).

Lei *543, 851* (4).

Liang *62369, 62465, 64191, 64246, 65061, 65179* (4).

Loh *FRI 17130* (1).

Madani *SAN 44256* (2).

McClure *CCC 9496* (4).

Maingay *Kew Distribution No. 280* (1).

Mallonga *FB 26473* (3).

Meijer *SAN 21746* (2).

Meijer & Stone *SAN 58909* (2).

Mikil *[SAN] 30331* (1).

Muin [bin] Chai *SAN 25571* (1).

Murdoch *154* (1).

Murthy & Ashton *S 22677* (1).

Ng *FRI 1171, FRI 1884* (1).

Nicholson & Patrick P. Sam *SAN 15404, SAN 17046* (2).

Oro *FB 31048* (1).

Paijmans *105, 158* (1).

Parker *2488, 2768* (1).

Pickles *S 3914, S 3935* (1).

Poilane *1498, 7957, 8025, 8037, 10287, 10300, 11123, 11195, 11242* (4).

Porter *[Wallich Catalog No.] 7756* (1).

Purseglove *5370* (1).

Rahmat si Boeea *7975* (1).

Ramos & Convocar *BS 83811, BS 83927* (3).

Ramos & Pascasio *BS 34681, BS 35058, BS 35184, BS 35193* (3).

Ridley *3467, 3639a, 4741, 5587* (1).

Sadau *[SAN] 42569, [SAN] 49548* (1).

Sam, Patrick P., *SAN 20650a, SAN 26359, SAN 26377* (2).

Scortechini *11801* (1).

Shah & Kadim *486* (1).

Sibat ak Luang *S 13960, S 21938, S 21984, S 22991* (1).

Singh *SAN 29961* (1).

Smith & Chai *S 27649* (1).

Smythies, Wood, & Ashton *SAN 17077* (1).

Soepadmo et al. *KLU 11742* (1).

Soepadmo & Mahmud *1147* (1).

Stone *8905, 13908, 15088* (6).

Suppiah *FRI 11944* (1).

Tingguan *SAN 36336* (1).

Toipin *SAN 40708* (2).

de Voogd *211* (1).

Wang *34303* (4).

Whitmore *FRI 3955, FRI 4020, FRI 12504* (1).

Wood *SAN 16033* (2); *KEP 76090* (1).

Yates *2571* (1).

Yeob *CF 834* (1).

Addendum

Since this article went to press, the fruit of *Maclurodendron magnificum* has been collected for the first time: W. Malaysia: Pahang: summit area of Gunong Ulu Kali, *Stone 15088-bis* (CANB, spirit collection; KLU). Thanks are extended to Dr. Stone for sending the sample of this material to Canberra. Its description follows.

Fruits glabrous, subglobose, about 10 mm wide, apex rounded and with 4 separate (about 5 mm apart) scars of stylar elements. Seed 1 per locule (each paired with an aborted ovule), minutely and irregularly reticulate, about 5 mm long, outer testa spongy.

In all of the species of *Maclurodendron* the style consists of four coherent stylar elements and is deciduous early in the development of the fruit. Here the scars of the stylar elements become widely separated as the fruit matures, whereas in all of the other species

they remain confluent at the apex of the fruit. If, as is suggested, *Maclurodendron* has evolved from a genus resembling *Melicope* (the fruits of which are usually nearly apocarpous and always have widely separate stylar element scars), the former character state probably represents the more primitive condition in the genus.

The following amended classification of the species of *Maclurodendron* takes into account this new differential fruit character and the characteristics of the testa of the previously-unknown seeds of *M. magnificum.*

Outline of species relationships

Scars of stylar elements widely separate in fruit; outer testa consisting of a spongy layer bounded externally by a shiny pellicle, the surface irregularly reticulate . . 1. *M. magnificum*

Scars of stylar elements confluent at the apex of the fruit

Outer testa consisting of a spongy layer bounded externally by a shiny pellicle, the surface reticulate

Surface of testa irregularly reticulate . . . 2. *M. porteri*
. . . . . 3. *M. pubescens*

Surface of testa regularly reticulate . . . . 4. *M. obovatum*
. . . . . 5. *M. oligophlebium*

Outer testa consisting only of a shiny pellicle, the spongy layer obsolete, the surface irregularly roughened . . . . . 6. *M. parviflorum*

Notes on *Gardenia* and *Acranthera* (Rubiaceae) from Peninsular Malaysia

WONG KHOON MENG
Forest Research Institute, Kepong

Summary

The genus *Gardenia* (Rubiaceae) is represented in Peninsular Malaysia by seven species of which two are shrubs and five are trees. Within the most variable species, *G. tubifera* Wall., two varieties are recognised, i.e. var. *tubifera* and var. *subcarinata* Corner; the former variety is shown to exist as two forms, forma *tubifera* and forma *elata* (Ridl.) Wong. Two species, *G. coronaria* Buch.-Ham. and *G. pterocalyx* Val., have not been previously recorded in accounts of the genus in Peninsular Malaysia. A key to all seven species is provided. Three taxa formerly included under *Gardenia* are transferred to *Acranthera*, providing the first record of the latter genus in Peninsular Malaysia; the new combinations are *Acranthera pulchella* (Ridl.) Wong and *A. didymocarpa* (Ridl.) Wong.

Introduction

Since Ridley's account of the genus *Gardenia* in the Malay Peninsula (Ridley, 1923) the only amendment has been that by Corner (1938) who reduced three of the species listed by Ridley to synonymy, under *G. tubifera*.

The present study provides an updated list of *Gardenia* species indigenous to the Malay Peninsula; of the seven species, *G. tubifera* is the most variable, and an account of the variation is therefore presented. These seven species may be keyed out by distinctive features of the flowers and fruits.

Although sectional delimitation within the genus cannot be dealt with prior to a worldwide revision, it is shown that the section *Gardeniella* Ridley (Ridley, 1909) was founded on three species which cannot be admitted within *Gardenia*, but which belong to the genus *Acranthera* instead.

Variation and Synonymy in *Gardenia tubifera*

Corner (1938) had already proposed that *G. speciosa* (Hk.)Hk.f., *G. elata* Ridl. and *G. resinifera* Korth. are conspecific with *G. tubifera* Wall.

The type specimen of *G. elata* (described in 1918) matches the details of *G. speciosa* (in *Ic. Pl.*, 1852, t.824, as *Randia speciosa* Hk.). Craib (1932) realised that *G. speciosa* (Hk.)Hk.f. (described in 1880) was a homonym of *G. speciosa* Salisb. (described in 1796) and renamed Hooker's species as *G. lobbii*.

When Ridley (1923) elaborated on these identities, he had the impression that *G. tubifera* was generally small-leafed ("leaves . . . 3.75 to 6 in. long, 1.5 to 2 in. wide") in contrast with *G. elata* ("leaves . . . 9 in. long, 3.5 in. across"); this is borne out by the specimens he had annotated at Singapore. That there is great variation in the dimensions

of mature open flowers is seen in the type specimen of *G. elata,* where two such flowers had the contrasting corolla-tube lengths of 6.6 cm and 11.4 cm. I agree with Corner (1938) who, in discussing the variations in leaf size, lengths of calyx-tube and corolla-tube, regarded the specimens *SFN 32440* and *SFN 32368* as intermediates between *G. speciosa, G. elata* and *G. tubifera.* I further agree with him in considering *G. resinifera* (with ribbed calyx-tubes) as a variety of *G. tubifera* (which otherwise has smooth calyx-tubes), named by him as *G. tubifera* var. *subcarinata* (Corner, 1938).

As *G. tubifera* Wall. (described in 1824) is the earliest name for this species, it takes precedence over the others. The synonymy for *G. tubifera* is thus :

G. speciosa (Hk.)Hk.f., *Fl. Brit. Ind.* 3 (1880) 117, non Salisb. (1796);

G. elata Ridl., *J. Str. Br. As. Soc.* 79 (1918) 81;

G. resinifera Korth. in Ridley, *Fl. Mal. Peninsula* 2 (1923) 82;

G. lobbii Craib, *Fl. Siam. En.* 2 (1932) 120.

The two varieties of *G. tubifera* are keyed out as follows:

Calyx-tube smooth . . . . . *G. tubifera* var. *tubifera*

Calyx-tube ribbed . . . . . *G. tubifera* var. *subcarinata* Corner, *Gard. Bull. S.S.* 10 (1938) 48.

While Corner was correct in observing that these entities formed a continuous range with regard to the characters mentioned, there is a tendency among the specimens with smooth calyx-tube (i.e. agreeing with *G. tubifera* var. *tubifera*) to group in two different directions (Fig. 1).

These two groups are two recognisable forms, keyed out as follows:

1. Leaves glabrous below, with widths not exceeding 6 cm; calyx-tube 0.8 – 2.0 cm long; corolla-tube 2.5 – 7.5 cm long; fruits to 3.5 cm across; plants usually found in lowland sites near the coast or swampy areas . . . . . *G. tubifera* var. *tubifera* forma *tubifera*

1. Leaves with puberulent veins on the undersurfaces, with widths often reaching 6 – 12 cm although smaller leaves may be present; calyx-tube 1.5 – 3.5 cm long; corolla-tube often 6.5 – 14 cm long; fruits to 5 cm across; plants found in lowlands to hill forest . . . . . *G. tubifera* var. *tubifera* forma *elata* (Ridl.) Wong, **stat. nov.**

Basionym : *G. elata* Ridl., *J. Str. Br. As. Soc.* 79 (1918) 81.

Synonyms : *G. speciosa* (Hk.)Hk.f., *Fl. Brit. Ind.* 3 (1880) 117, non Salisb. (1796); *G. lobbii* Craib, *Fl. Siam. En.* 2 (1932) 120.

Type : *Wray 4265,* Perak, Selama (SING; also syntype of *G. elata*).

It is possible that the range of variation present within *G. tubifera* reflects incipient evolutionary changes such that the modifications in floral characters have not yet progressed to the stage where they fall into discrete groups.

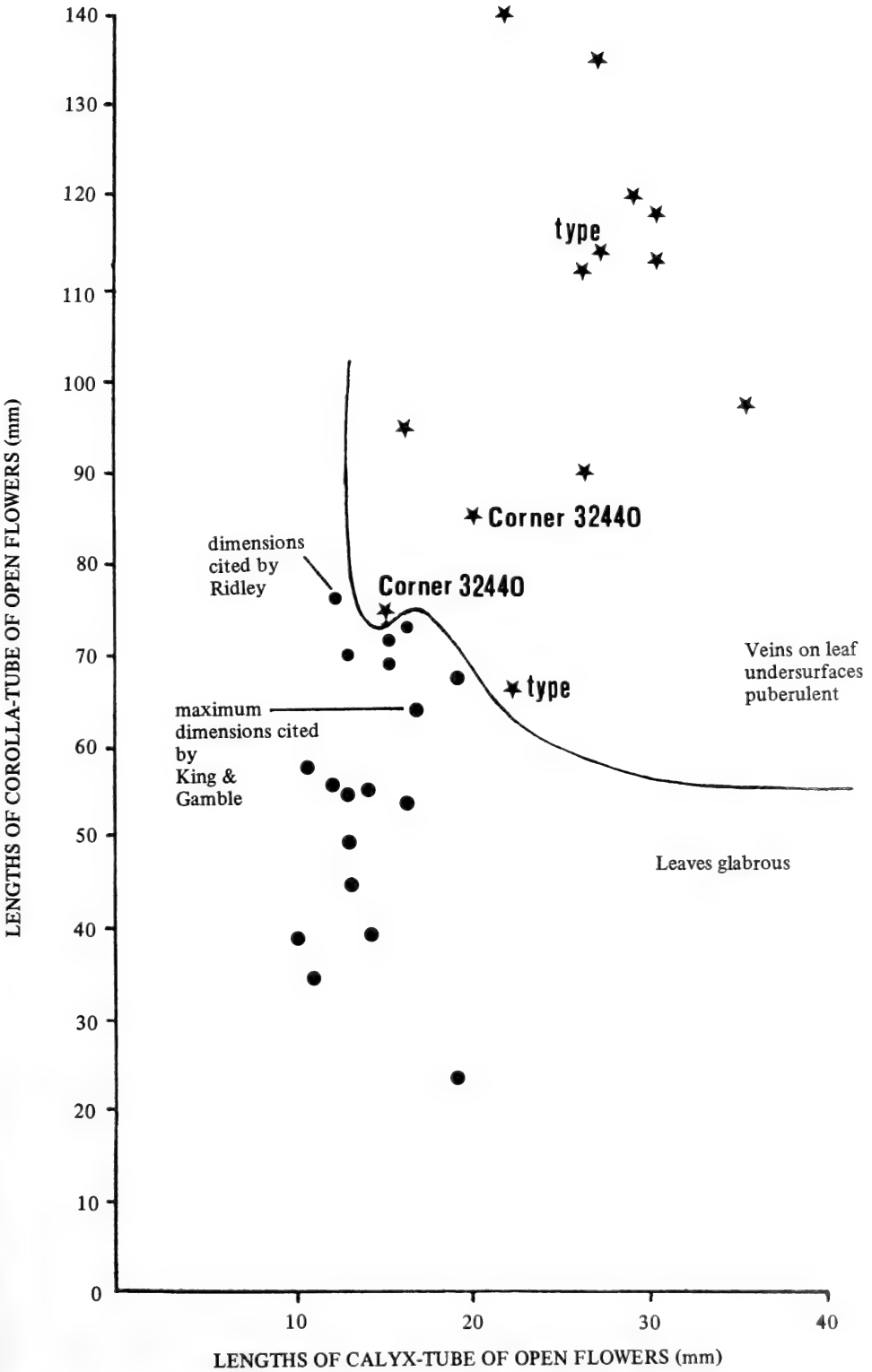


Figure 1. Corolla-tube and calyx-tube lengths compared between specimens of *Gardenia tubifera* sensu Ridley (●) and *G. elata* sensu Ridley (★).

Specimens examined :

G. tubifera var. *subcarinata*

Alvins s.n. 23.3.1886. Malacca, Jus (SING)
Burkill & Haniff SFN 17129. Pahang, Pekan (SING)
Chan FRI 25155. Trengganu, Bt. Bauk F.R. (KEP)
Chelliah KEP 98143. Penang, Pantai Acheh (SING, KEP)
Cockburn FRI 7300. Kelantan, Relai F.R. (KEP)
Curtis 686. Penang, Govt. Hill (SING)
Derry 360. Malacca, Bt. Sadanau (SING)
Everett FRI 13596. Perak, Taiping (KEP); FRI 13766. Kedah, Bt. Enggang (KEP)
Foxworthy 7960. Selangor, Sg. Buloh (SING, KEP)
Goodenough s.n. 25.1.1890. Singapore, Changi (SING)
Kochummen FRI 2919. Perak, Maxwell Hill (KEP); FRI 11496. Selangor, Kanching (KEP)
Mat Ariff KEP 7501. Kedah, G. Jerai (SING)
Md. Nur SFN 34129. Selangor, Sg. Tinggi (SING)
Ngadiman SFN 34926. Singapore, Bt. Timah (SING)
Phytochem. Survey of Malaya KL 2989. Selangor, 26 m.s. K.L. to Selangor (SING)
Ridley 2588; 4416. Singapore, Garden Jungle (SING)
Sinclair SFN 10863. Johore, Sg. Bang (SING); SFN 39695. Penang, Tiger Hill (SING)
Stone, Sharif & Mahmud KLU 12264. Pahang, Tasek Bera (KEP)
Wray, Jr. 2522. Perak, Matang Jambu (SING)
Yeok KEP 4753. Selangor, Kelambu F.R. (SING)
Zahir Yusoff KEP 99132. Pahang, Ulu Krau (SING)

G. tubifera var. *tubifera* forma *tubifera*

Alvins 11. Malacca, Selandar (SING)
Bain KEP 5985. Johore, Sg. Johol (KEP)
Bidin 3151. Johore, Endau (SING)
Burkill HMB 2640. Malacca, Bt. Berendam Rd. (SING, KEP) : SFN 1434. Malacca, Sg. Tebong (SING)
Burkill & Haniff SFN 16374. Malacca, Alor Gajah (SING)
Burn-Murdoch SFN 304. Pahang, Tasek Chini (SING)
Corner SFN 24625. Johore, Bagan Limau (SING); SFN 25971. Johore, Darau (SING)
Derry 199. Malacca, Merlimau (SING)
Goodenough 1699. Malacca, Sg. Udang (SING)
Hardial S. & Samsuri HS 1092. Johore, Kluang (SING, KEP)
Henderson SFN 24126. Pahang, Sg. Bera (SING, KEP)
Lake & Kelsall s.n. 1892, Johore, K. Sembrong (SING)
Mat Asri FRI 25738. Negeri Sembilan, Simpang Pertang – K. Pilah road (KEP)
Md. Shah & Md. Ali MS 3147. Pahang, Rompin (KEP)
Ngadiman SFN 16114. Pahang, Lubok Paku (SING); s.n. 14.1.1938 & s. loc. (SING)
Ridley 1375; 1388. Pahang, Pekan (SING); 4209. Johore, Kota Tinggi (SING); 11139. Johore, Bekok River (SING); s.n. 1895. Singapore, Choa Chu Kang (SING); s.n. 20.8.1909. Pahang, Pekan (SING)
Scortechini 1775. Perak, K. Depang (SING)
Watson KEP 5816. Johore, Ulu Mersing (KEP)

G. tubifera var. *tubifera* forma *elata*

Abu KEP 4652. Selangor, Sg. Buloh F.R. (SING, KEP)
Alvins 2364. Malacca, Chaban (SING)
Burkill SFN 2509. Malacca, Kemandore (SING); KEP 3313. Selangor, Sg. Buloh (KEP)
Chan FRI 6777. Kedah, Ulu Muda (KEP)
Corner SFN 28736. Johore, Sg. Berassau (SING, KEP); SFN 32440. Johore, Sg. Sedili (SING)
Everett FRI 13631. Pahang, north of Kg. Teris (KEP)
Hullett 445. Singapore, Bt. Timah (SING)
Kiah SFN 32368. Johore, Sg. Kayu (SING); SFN 35148. Kedah, Koh Mai F.R. (SING)

Kochummen FRI 2457. Perak, Kg. Kangsar (KEP)
Md. Shah & Md. Noor MS 1833. Pahang, Ulu Sg. Sat (SING, KEP)
Ngadiman SFN 35595. Singapore, Bt. Timah (SING)
Phytochem. Survey of Malaya KL 2018; KL 2138. Selangor, Ulu Langat (KEP)
Ridley s.n. 1891. Selangor, Sg. Buloh (SING); s.n. 1907. Singapore, Bt. Timah (SING)
Soh KEP 15411. Pahang, Rompin (SING)
Suppiah FRI 11681. Kelantan, Ulu Lebir (KEP)
Symington KEP 24190. Selangor, Bt. Enggang (SING, KEP)
Wray 4265. Perak, Selama (SING, syntype of *Gardenia elata* Ridley)
Zainuddin FRI 17945. Trengganu, Jerteh (KEP)

Species Characters and a Key To Peninsular Malaysian *Gardenia*

In the Malay Peninsula, there are only two speices of *Gardenia* which are shrubs (*G. campanula* and *G. tentaculata*), and these have flowers with the corolla campanulate whereas the tree species are all characterised by a salverform corolla (Fig. 2).

Among the five arborescent species, the most reliable distinguishing characters are the calyx and fruit structure, whether the calyx-tube and fruit are smooth, ribbed or bear wing-like appendages. The length of the corolla-tube seems an undependable character, as shown earlier, while the extent to which the calyx ensheaths the corolla-tube is significant only in *G. griffithii* and *G. pterocalyx*.

A key to the Peninsular Malaysian species of *Gardenia* follows:

1. Corolla campanulate
   2. Calyx teeth often 0.5 – 1 cm long; corolla less than 2 cm long; fruits ribbed on the surface . . . . . *G. tentaculata* Hk. f.
   2. Calyx teeth less than 0.3 cm long, corolla often 3 – 4 cm long; fruits smooth . . . . . *G. campanula* Ridl.

1. Corolla salverform
   2. Calyx-tube with expanded wing-like appendages down its length
      3. Calyx wings triangular, the wings at the top of the calyx-tube; fruits ribbed . . . . . *G. carinata* Wall.
      3. Calyx wings running down the entire calyx-tube, the wings broadest at their middle; fruits with narrow wings continuing from the calyx . . . . . *G. pterocalyx* Val.
   2. Calyx-tube without any expanded wing-like appendages
      3. Fruits obovoid, ribbed . . . . . *G. coronaria* Buch.-Ham.
      3. Fruits globose, smooth
         4. Calyx-tube sheathing to half the length of the corolla-tube . . . . . *G. griffithii* Hk. f.
         4. Calyx-tube sheathing only to a third the length of the corolla-tube, or less . . . . . *G. tubifera* Wall.

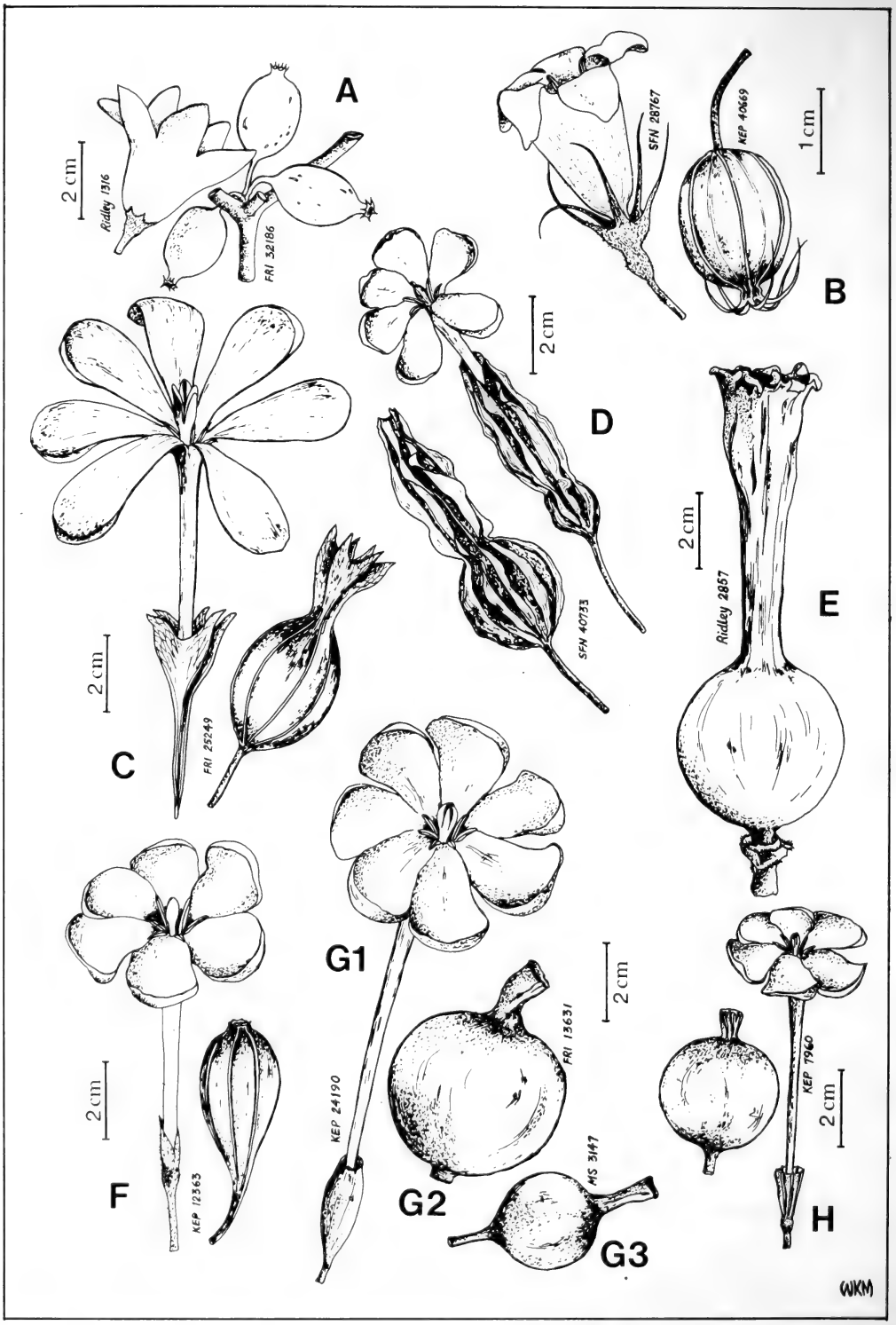


Figure 2. Flowers and fruits of *Gardenia* species. A. *G. campanula;* B. *G. tentaculata;* C. *G. carinata;* D. *G. pterocalyx;* E. *G. griffithii;* F. *G. coronaria;* G. *G. tubifera* var. *tubifera* (G1 and G2, flower and fruit, respectively, of forma *elata;* G3, fruit of forma *tubifera*); H. *G. tubifera* var. *subcarinata.*

The species *G. coronaria* and *G. pterocalyx* were not included by Ridley (1923). *G. coronaria* was first recorded by Craib (1932) to occur in the Malay Peninsula and is known only from Langkawi in the extreme north-west; it is mainly an Indo-Chinese species. Malayan specimens of *G. pterocalyx,* a species not previously recorded from the Malay Peninsula, have rounded leaf apices while Bornean specimens seen have leaves with a short tip. The specimens examined are listed below.

G. coronaria

Alphonso and Samsuri A128. Langkawi, Kuah (SING)
Chelliah FRI 6916. Langkawi (KEP)
Corner s.n. 12.11.1941. Langkawi, Kuah (SING)
Curtis s.n. 3.1892. Langkawi, Trutow (SING)
Holttum SFN 15082. Langkawi (SING)
Md. Haniff & Md. Nur SFN 7560. Langkawi, Bt. Penarak (SING)
Rahim KEP 12363. Langkawi, Penarak F.R. (SING)

G. pterocalyx

Henderson SFN 24138. Pahang, Sg. Bera near Tasek Bera (SING)
Mahmud bin Sider s.n. May 1970. Pahang, along the road to G. Ulu Kali alt. 1200 ft a.s.l. (KLU)
Poore 951. Pahang, Tasek Bera, forest edge in swamp (KLU)
Sinclair & Kiah SFN 40733. Trengganu, Paya Bt. Pakbeh, sandy gelam forest (SING)
Stone 6614. Pahang, Tasek Bera, in the lake, lower part of trunk immersed (KLU)
Stone 9484. Pahang, Tasek Bera, alt. 50 ft a.s.l. (KLU)

Species Transferred from *Gardenia* to *Acranthera*

Ridley's *Gardenia didymocarpus, G. pulchella* and *G. virescens* are not admissible to the genus *Gardenia* because of the following discrepancies:

(i) The stamens have long filaments arising from the base of the corolla-tube and basi-fixed anthers which are connivent around the stigma. In *Gardenia,* the stamens are distinctly epipetalous, attached near the month of the corolla-tube, and the anthers are never connivent around the stigma.

(ii) The fruit is a narrowly cylindric berry, with many tuberculate seeds. In typical *Gardenia,* the fruit is an ellipsoid to globose berry and the seeds have a non-tuberculate testa.

(iii) The stipules are pronounced structures with long linear teeth on the margin, whereas in typical *Gardenia* the stipules have an entire margin.

There are only a few genera in the Rubiaceae which possess the feature of having the anthers connivent around the stigma, and borne on filaments inserted at the base of the corolla-tube. These genera include *Argostemma, Neurocalyx, Steenisia* and *Acranthera.* Table 1 provides a comparison of the main features of these genera with the species placed in *Gardenia* by Ridley (1909); it will be appreciated that Ridley's taxa in question belong to the genus *Acranthera.*

Argostemma is easily set apart from the other genera by its exsert anthers which often open by pores, as well as its entire stipules.

Table 1. Morphological comparisons between the genera *Argostemma, Neurocalyx, Steenisia, Acranthera* and specimens representing *Gardenia didymocarpus* Ridl., *G. pulchella* Ridl. and *G. virescens* Ridl.

	Argostemma	*Neurocalyx*	*Steenisia*	*Acranthera*	*G. didymocarpus, G. pulchella & G. virescens*
Stipules	Entire	Bifid to laciniate	Laciniate to fringed with long teeth	Entire to apically slightly dentate	Fringed with long teeth
Inflorescences	Terminal on main shoots	Axillary, racemes or heads	Axillary, thyrsoid	Terminal on main shoots or at ends of axillary short-shoots	At ends of axillary short-shoots
Stamen filaments	Very short, the anthers sub-sessile	Very short, the anthers sub-sessile	Very short, the anthers sub-sessile	Ranges from short to longer than the anthers	Long, much longer than the anthers
Anthers	Exsert from the corolla-tube, often opening by pores, sometimes longitudinally	Included within the corolla-tube, dehiscing longitudinally			
Ovary	2-celled, axile placenta	2-celled, axile placenta	2-celled axile placenta	1-celled, parietal placenta	1-celled, parietal placenta
Fruit	Globose capsule, dehiscing apically or operculate	Oblong-ovoid capsule, dehiscent	Oblong-ovoid capsule, dehiscent	Oblong to cylindric berry, indehiscent	narrowly cylindric berry, indehiscent

The Bornean genus *Steenisia* and the related Ceylonese-Indian *Neurocalyx* (Airy Shaw, 1937; Bakhuizen, 1952) possess stipular structures closely resembling those in Ridley's taxa here discussed, but differ in their axillary inflorescences, dehiscent capsules and two-celled ovaries with axile placentation.

While Bentham & Hooker (1873) and Hooker (1882) have stated that the ovary in *Acranthera* is unilocular with parietal placentation, Bremekamp (1947) upheld Stapf's view (1894) that the ovary and fruit are perfectly bilocular, and (in Bremekamp's words) "may, however, easily be mistaken for unilocular, because the dissepiment is rather thin in the middle and, therefore, is easily torn when the razor, with which the sections are made, is not sufficiently sharp." Subsequently, Bakhuizen (1975) has affirmed, for species in Thailand at least, that the ovary is initially one-celled and afterwards two-celled in appearance, so caused by two intruding placentas. Serial sectioning of young and mature fruits from Bornean specimens of *Acranthera* support the observation by Bakhuizen. In Ridley's *G. didymocarpus, G. pulchella* and *G. virescens,* this is also the case, the ovary and young fruit being one-celled, with two parietal placentas which gradually meet and give the impression of a bilocular condition in mature fruits.

Ridley (1909) noted that "the genus *Acranthera* contains only plants with strongly peduncled terminal cymes." In *G. pulchella,* the flowers are in clusters of one to several on short axes from the leaf axils; in *G. didymocarpus,* the flowers are solitary but are borne on short axes which sometimes bear a few reduced bract-like appendages below the actual flower stalk. While most known *Acranthera* have well developed terminal inflorescences and are clearly hapaxanthic with regard to the main vegetative shoot, there are other species in the genus which have flowers on axillary short-shoots (Bremekamp, 1947) and are pleonanthic with regard to the main vegetative shoot.

On the basis of these species, Ridley (1909) erected a new section of the genus *Gardenia,* named *Gardeniella,* mentioning *G. tentaculata* as a connecting link between this section and typical *Gardenia;* however, he had effectively only commented that the seeds of *G. tentaculata* are "like those of *G. pulchella* . . . . pustular." *G. tentaculata* is a true *Gardenia* since it possesses single-celled ellipsoid fruits and compressed seeds. The only point which may need clarification would be the statement by King & Gamble (1903) that the anthers are "at the base of the corolla-tube" which sounds like the situation in *G. pulchella,* but the two are entirely different. In *G. tentaculata,* the anthers are sessile and dorsifixed just below the corolla mouth, with the lower end of the anther reaching the base of the corolla-tube, while in *G. pulchella* the anthers are borne on long filaments from the base of the corolla-tube.

From the above considerations, it may be concluded that both *G. pulchella* and *G. didymocarpus* should be transferred to *Acranthera;* I have found *G. pulchella* and *G. virescens* to be conspecific, with the former name taking precedence. It also follows that Ridley's section *Gardeniella* is merely a synonym of *Acranthera.*

These two species of *Acranthera* may be compared as follows:

1. Leaves short hairy below, flowers in clusters of 1-several, corolla greenish to white with pink spots inside . . . . . *Acranthera pulchella* (Ridl.) Wong. **comb. nov.** (Fig. 3)
   Gardenia pulchella Ridl., J.F.M.S. Mus. 4 (1909) 31, basionym;

Gardenia virescens Ridl., J.F.M.S. Mus. 4 (1909) 32, **syn. nov.**
Typification and specimens examined :
Ridley 13606, Pahang, Telom (SING; lectotype of *Acranthera pulchella,* here chosen)
Ridley, s.n. 1891, Perak, Taiping Hills, 5000 ft (SING; type of *Gardenia virescens*)
Henderson SFN 10941, Pahang, Lubok Tamang (SING)
Henderson SFN 11537, Pahang, Fraser's Hill (SING)
Burkill & Haniff SFN 13182, Perak, Maxwell Hill (SING)
Md. Nur SFN 11233, Pahang, Fraser's Hill (KEP)
Ridley did not designate any type for *G. pulchella* but mentioned "Common on banks at Telom" – his specimen from Telom, annotated by him as such, may be regarded as type material. Since Ridley also did not designate a type species for section *Gardeniella, G. pulchella* Ridl. is here selected as the lectotype species, henceforth to be cited as a synonym of *Acranthera.*

1. Leaves densely long hairy below, flowers solitary, corolla yellow with pink spots inside . . . . . *Acranthera didymocarpa* (Ridl.) Wong, **comb. nov.**
Gardenia didymocarpus Ridl., J.F.M.S. Mus. 4 (1909) 32, basionym.
Typification and specimens examined :
Ridley 7573, Selangor, Ginting Bidai (SING; syntype of *Gardenia didymocarpus;* lectotype of *Acranthera didymocarpa,* here chosen)
Ridley s.n. 1897, Selangor, Pahang Track 15th mile (SING; syntype of *Gardenia didymocarpus*)
Burkill SFN 3183, Negeri Sembilan, G. Tampin (SING)

Acknowledgements

Mr. K.M. Kochummen, Dr. F.S.P. Ng and Dr. B.C. Stone have been helpful in providing various views and criticisms during the preparation of this paper. The Keepers of the Herbaria at the Singapore Botanic Gardens and University of Malaya have been most kind in allowing the study and loan of specimens in their care.

References

Airy Shaw, H.K. (1937). The genus *Neurocalyx* in Borneo. *Kew Bull.* 5: 281-290.

Bakhuizen van den Brink, Jr. (1952). *Steenisia,* a new genus of Malaysian Rubiaceae. *Webbia* 8: 381-382.

(1975). A synoptic key to the genera of the Rubiaceae of Thailand. *Thai Forest Bull.* 9: 15-55.

Bentham, G. & J.D. Hooker (1873). *Genera Plantarum* 2: 64.

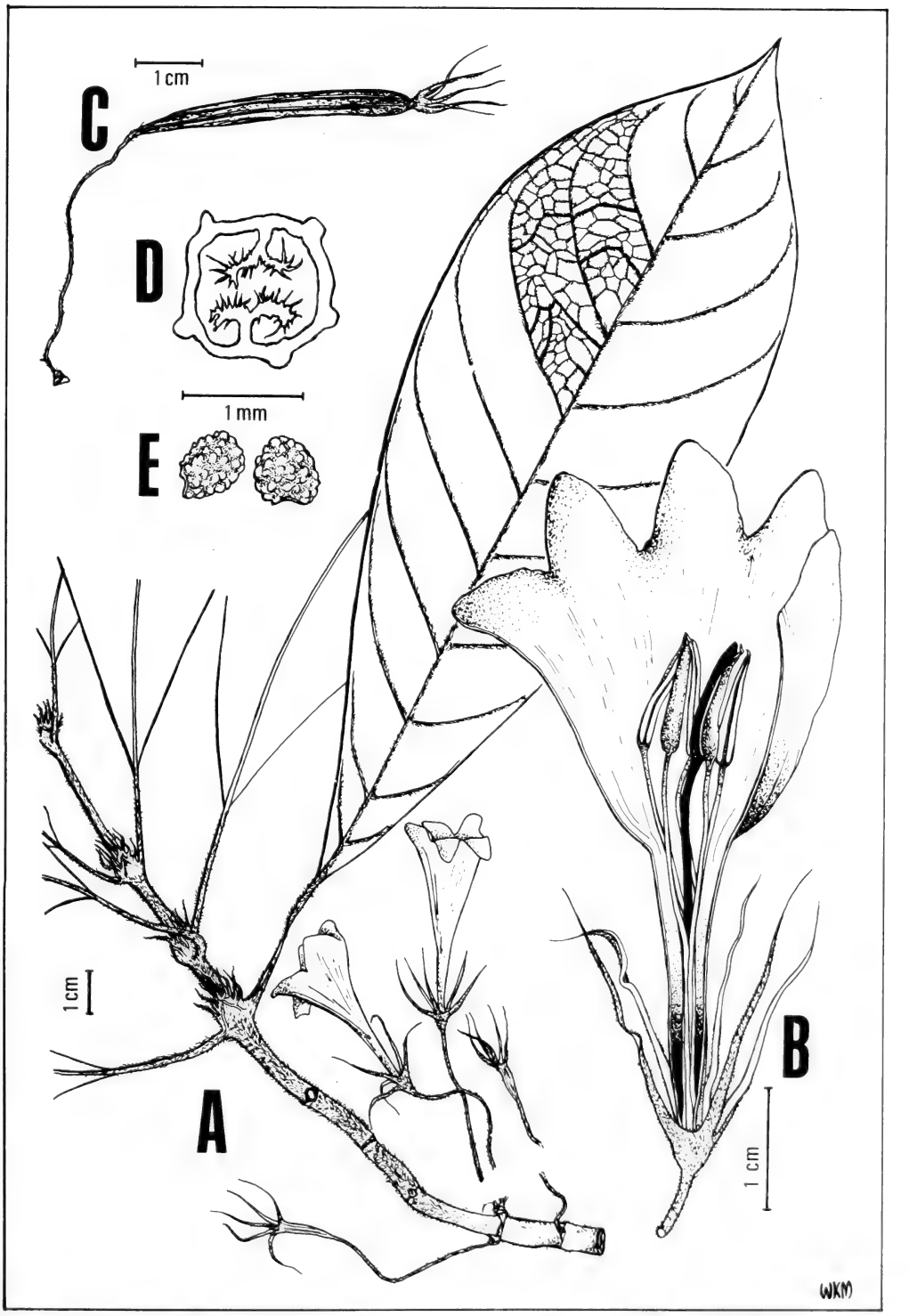


Figure 3. *Acranthera pulchella* (Ridl.) Wong. A. Twig with leaves and flowers; B. Flower with corolla-tube cut apart to reveal stamens and style; C. Mature fruit; D. Transverse section through young fruit showing two parietal placentas; E. Seeds from mature fruit. All based on the type specimen (Ridley 13606) except D (from SFN 10941).

Bremekamp, C.E.B. (1947). A Monograph of the genus *Acranthera* Arn. ex Meisn. (Rubiaceae). *J. Arn. Arb.* 28: 261-308.

Corner, E.J.H. (1938). Notes on the Systematy and Distribution of Malayan Phanerogams. I. *Gard. Bull. S.S.* 10: 46-48.

Craib, W.G. (1932). *Gardenia.* In: *Florae Siamensis Enumeratio* 2: 115-124.

Hooker, J.D. (1882). The *Flora of British India* 3: 92.

King, G. & J.S. Gamble (1903). *Materials for a Flora of the Malay Peninsula* 2 (72). *Gardenia,* pp. 216-221.

Ridley, H.N. (1909). The Flora of the Telom and Batang Padang Valleys. *J.F.M.S. Mus.* 4: 30-32.

(1923). The *Flora of the Malay Peninsula* 2: 79-84. Reeve, London.

Stapf, O. (1894). On the Flora of *Mount Kinabalu* in North Borneo. *Trans. Linn. Soc., Bot.* Ser. II, 4: 172.

Induced Deficiency Symptoms of Nitrogen, Phosphorus, Potassium, Magnesium and Iron in *Axonopus compressus* Cultured in Sand

THAI WU FOONG, CECELIA SENDI ONG* AND *Sh.* FAUZIAH *bte S.* A. BAKAR
Botanic Gardens, Parks & Recreation Department, Singapore

Abstract

The deficiency symptoms of N, P, K, Mg and Fe were successfully induced in *Axonopus compressus* cultured in sand. Visual deficiency symptoms are presented and described in detail. Dry matter of above- and below-ground parts was determined. Data of elemental analysis of above-ground parts of normal and deficient plants are tabulated for comparison.

Introduction

Axonopus compressus commonly known as carpetgrass or locally as cowgrass, is a native of the West Indies. Its pantropical distribution has been encouraged mainly by its quality as a pasture grass (Gilliland, 1953). It grows on non-fertile, wet, acid, sandy and sandy loam soils, where moisture is near to the surface most of the year and on soil too poor for other pasture plants.

In Singapore, *Axonopus compressus* (Swartz) Beauv. has become the major turfgrass groundcover used for sports fields, home lawns, parks, road verges and other open spaces, in recognition of its hardy nature – high resistance to wear and tear, rapid rate of establishment notwithstanding poor soil conditions, competitive superiority over weeds and inherent resistance to diseases and insect pests. However, *Axonopus compressus* is rarely found as a pure stand unless under stringent control as on home lawns. Often it is mixed with minor populations of interspersed *Digitaria didactyla, Cynodon dactylon* and *Zoysia matrella* (Anonymous, 1977) whose coexistence is tolerated.

Recently, patches of chlorotic *Axonopus compressus* were discovered in various horticultural locations in Singapore, especially where the soil pH values were 7.0 and above. Vengris (1973) reported that *Axonopus compressus* is very prone to iron deficiency, having the disposition to become chlorotic at pH 7.0 and above and that the ideal pH range for *Axonopus compressus* is 5-5.5. Whereas the nutritional requirements of temperate grasses have been studied in some detail (Beard, 1973 & 1979; Madison, 1971 and Vengris, 1973), little is known about the nutrition of *Axonopus compressus.* The following nutrient-omission trial was designed to study the deficiency symptoms of essential elements in *Axonopus compressus* and to specifically relate the chlorotic symptom encountered in the field to iron deficiency.

Materials and Methods

Clusters of *Axonopus compressus* with intact root systems were collected from the grounds of the Singapore Botanic Gardens and washed free of all soil contaminants. After

*The second author relinquished her post on 1 June 1982.

a final rinse with deionized water, they were transplanted into plastic pots approximately 20 cm in diameter, filled with washed sea sand. The sand had been thoroughly cleaned with water to remove fine clay and silt particles, and soluble salts, then leached with N HCl to remove exchangeable cations if any, and finally rinsed with deionized water until acid-free. The top of each pot was lined with a layer of washed granite chips to prevent the possible loss of sand due to the splashing by the rain and to reduce evaporation. The planted pots were left to establish under shade for a few days before being exposed to full sun on beaches in open ground.

Nutrient formulations were adapted with minor adjustments from Asher (1973) and are tabulated (Appendixes 1 & 2). Such formulations have been successfully employed by Chai (1978) in inducing mineral deficiency symptoms in Choy Sam (*Brassica chinensis*) by solution culture. Salinity of each nutrient feed was checked and the pH corrected to 5-5.5 before application.

Each treatment as well as the control are replicated 6 times. The controls, given a full complement of essential elements, were kept for comparison. In addition, 6 pots were incorporated for a study of the perseverence of *Axonopus compressus*. The latter was raised solely with deionized water.

The pots were fertilized on alternate days at the rate of 150 ml per pot and supplemented with deionized water on other days.

Deficiency symptoms were registered photographically as they appeared and where possible, the sequential development of symptoms was also photographed. When the trial was 3-months old, a representative pot from each treatment showing deficiency symptoms was harvested and the root system compared with that of the control. The remaining pots were also harvested and separated into roots and tops. Three lots of these were washed, dried at 80°C, pulverized and used for elemental analyses. The other three lots were dried at 105° C for dry-matter determination.

Results and Discussions

I. Dry-matter determination

Dry weights of tops and roots of various treatments are summarized in Tables 1 and 2. That the dry weight of the root system was about 3 times that of the top in the control may be due to the compaction-free sand medium which is conducive to profuse root proliferation.

Table 1 : Dry-matter production of above-ground part

Treatment	*Dry matter of above-ground part (g/pot)	% of control
1. Control	9.53	100.00
2. Minus N	0.94	9.85
3. Minus P	1.16	12.17
4. Minus K	8.36	87.72
5. Minus all	0.70	7.35
6. Minus Mg	9.46	99.27
7. Minus Fe	9.23	96.85

*Average of 3 pots.

Table 2 : Dry-matter production of root system

Treatment	*Dry matter of root system (g/pot)	% of control
1. Control	29.43	100.00
2. Minus N	4.87	16.55
3. Minus P	4.19	14.24
4. Minus K	9.51	32.31
5. Minus all	4.35	15.39
6. Minus Mg	7.88	26.78
7. Minus Fe	9.17	31.16

*Average of 3 pots.

II. Description of symptoms

Initially all cultures turned reddish purple on exposure to full sun, irrespective of treatment, and this is thought to be a reactionary effect to heat. Later, as new blades emerged, these affected blades aborted.

Deficiency symptoms of total omission of nutrients, nitrogen, phosphorus, magnesium and iron became evident within the first four weeks of culture and became more marked with increasing period of starvation with respect to the element under study. Deficiency symptoms of potassium surfaced only after about 10 weeks and then concurred with a drastic reduction in proliferation. Such observations tend to suggest that nitrogen, phosphorus, magnesium and iron nutrition of *Axonopus compressus* may take priority initially over that of potassium.

Treatment 1 : Minus Nitrogen

The symptoms resembled those of total omission of nutrients. They were first seen on the older blades. A reddish purple tint initially manifested itself along the entire margin of the blade and extended from tip to base in a streaky manner. A purplish colouration has been described for bermudagrass suffering from prolonged nitrogen deficiency. The initial symptom, however, was chlorosis (Oertli, 1963 cited by Beard 1973). Gradually, the reddish purple colouration imbued the entire blade, with the veins being more outstandingly coloured. Eventually the blade became necrotic and died. Both tillering and blade size were markedly reduced. Inflorescences were either not formed or withered away prematurely (Plate 1 : a, b and c). The root system appeared stunted compared with that of the control (Plate 4 : a). Dry-matter production was reduced. (Table 1 & 2).

Treatment 2 : Minus Phosphorus

Phosphorus deficiency manifested itself by the spreading of a dark purple discolouration from tip to base of the blade, commencing with the older blades. This symptom is typical of phosphorus deficiency. This one-step development of the purple discolouration resembles that observed for Merion Kentucky bluegrass. (*Poa pratensis*). However in some temperate grasses e.g. seaside creeping bentgrass (*Agrostis palustris*) and Pennlawn red fescue (*Festuca rubra*), the colour development begins from dark green, turns to dull blue-green and then to purple (Beard, 1973). On some blades, the veins remained green. When the development of the dark purple colouration became advanced or complete, necrosis

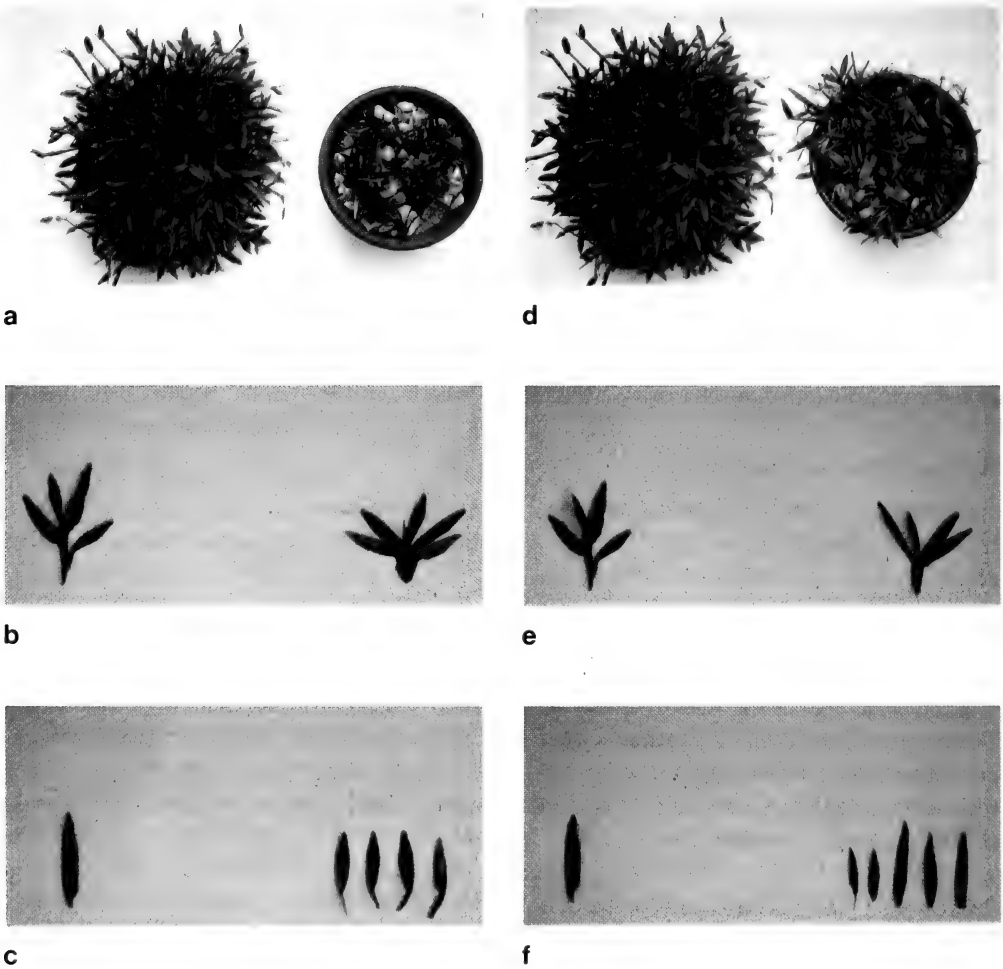


Plate 1. Deficiency symptoms : Top

Treatment 1 : a – c
a = Top view : control (left), Nitrogen-deficient (right)
b = Tiller : control (left), Nitrogen-deficient (right)
c = Sequence of symptom development : control (left), Nitrogen-deficient (right)

Treatment 2 : d – f
d = Top view : control (left), Phosphorus-deficient (right)
e = Tiller : control (left), Phosphorus-deficient (right)
f = Sequence of symptom development : control (left), Phosphorus-deficient (right)

began from tip to base and finally took its toll on the blade. Few new tillers were formed and blade size reduced. Inflorescences were either not formed or died prematurely (Plate 1 : d, e and f). The dry mass of the top and root was significantly reduced in comparison with that of the control (Plate 4 : b; Tables 1 & 2).

Treatment 3 : Minus Potassium

For the first 10 weeks of culture or thereabouts, no deficiency symptom was apparent. Growth was also unaffected. After 10 weeks of culture, symptoms began to emerge, accompanied by a distinct reduction in tillering and tiller size. The newly-formed blades were comparatively smaller than the old ones. Deficiency symptoms first appeared on the older blades as a partial interveinal chlorosis intermingled with a random display of dirty dark-brown speckles. Such interveinal chlorosis has been reported as a symptom of K deficiency in temperate grasses (Beard, 1973). In advanced deficiency, the tip of the blade became necrotic. This condition spread downwards and towards the base of the blade and literally killed it. Inflorescence production was checked at the later stage of deficiency (Plate 2 : a, b and c). The root system appeared smaller and had a lower dry weight than that of the control (Pate 4 : c; Table 2). Top dry-matter production was not very much reduced (Table 1) after 3 months as the recession in growth commenced only 10 weeks after treatment.

Treatment 4 : Total Omission of Nutrients

The overall symptom manifestation remarkedly resembled that of the minus nitrogen treatment as described above, indicating that nitrogen nutrition is ranked foremost for *Axonopus compressus* (Plate 2 : d, e and f). The root system was very much inhibited in the absence of all nutrients (Plate 4 : d). Dry-matter production was greatly reduced (Tables 1 & 2). Although old tillers died back and new ones were sparse, they were very persistent after a period of 3 months in an environment which was supposedly nutrient-free, thus showing the remarkable hardiness of *Axonopus compressus*. In Treatments 1, 2 and 4, the top growth was so very much reduced that the pots had a bare look.

Treatment 5 : Minus Magnesium

The development of magnesium deficiency symptoms in *Axonopus compressus* is perhaps, the most prominent in terms of the display of colours. The older blades were affected first. Initially interveinal chlorosis prevailed, followed by the spreading of a cherry-red colouration from tip to base. A random distribution of yellow speckles developed against the cherry-red background. In the advanced stage, the individual blade became uniformly coloured to a bright cherry-red and necrosis commenced from tip to base, causing mortality of the blade. This symptom manifestation is somewhat similar to that of magnesium-deficient temperate grasses. However, the blades in the present trial did not turn completely yellow (cf Beard, 1979). There was no apparent reduction in top growth and inflorescence production (Plate 3 : a, b and c; Table 1). The root system appeared healthy but had a lower dry weight than that of the control (Plate 4 : e; Table 2).

Treatment 6 : Minus Iron

Iron deficiency in *Axonopus compressus* began as a striking yellowing of blades as in iron-deficient temperate grasses (Beard 1973). The newly-emerged blades developed interveinal chlorosis while the older blades remained quite green and healthy. In the later stage

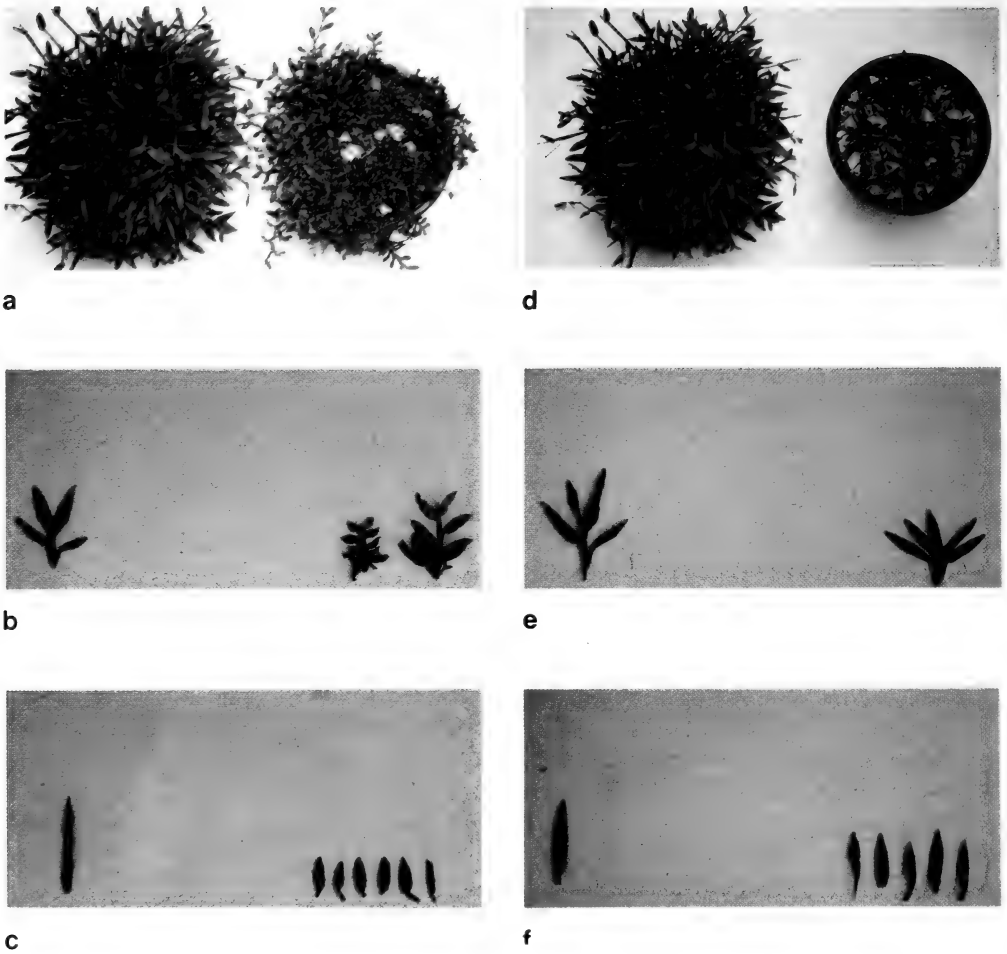


Plate 2. Deficiency symptoms : Top

Treatment 3 : a – c
a = Top view : control (left), Potassium-deficient (right)
b = Tiller : control (left), Potassium-deficient (right)
c = Sequence of symptom development : control (left), Potassium-deficient (right)

Treatment 4 : d – f
d = Top view : control (left), minus all (right)
e = Tiller : control (left), minus all (right)
f = Sequence of symptom development : control (left), minus all (right)

of iron deficiency, the younger blades were almost completely depleted of chlorophyll and exhibited an acutely ivory discolouration which spread to the older blades. Tip and marginal necrosis both occurred randomly. Eventually the blade died. Inflorescence formation did not appear to be affected (Plate 3 : d, e and f). Whereas the top dry-matter accumulation was not adversely affected, the dry weight of the root system was reduced to about 31% that of the control (Plate 4 : f; Table 1 & 2). The iron contents in the control and treated grass were quite marginal (Table 3). This may be taken to imply that the difference in the levels for deficiency and sufficiency is small.

The remainder of the trial was monitored for a further period of 3 months. Nevertheless, no deficiency symptoms of trace elements were evident, meaning that either the sand was still contaminated with traces of these elements sufficient for the normal growth of the grass or that *Axonopus compressus* is not very sensitive to deficiency of these trace elements.

III. Results of elemental analysis

Table 3 : Results of elemental analysis of above-ground parts of Axonopus compressus on a dry weight basis

Treatment	Control grass	Treated grass	% of control
1. –N	1.47% N	0.91% N	61.90
2. –P	0.22% P	0.08% P	36.36
3. –K	1.48% K	0.25% K	16.89
4. –Mg	2515.0 ppm Mg	538.0 ppm Mg	21.39
5. –Fe	137.5 ppm Fe	119.9 ppm Fe	87.20
		(0.83% N	56.46
		(0.17% P	77.27*
6. –all		(0.83% K	56.08*
		(579.0 ppm Mg	23.02
		(249.1 ppm Fe	181.16*

Deficiency symptoms were further confirmed by tissue analysis of the above-ground parts of the control and treated grass. The results are tabulated (Table 3). These data denote deficient levels but do not necessarily represent the critical levels at which deficiency symptoms just begin to appear.

Conclusion

The deficiency symptoms of N, P, K, Mg and Fe were induced in *Axonopus compressus* and further confirmed by elemental analysis of above-ground part. Whereas the deficiencies in the semi-macro elements Mg and Fe only resulted in a multitude of dis-

*In the treatment with deionized water only, the efficiency of *Axonopus compressus* to accumulate P, K and especially Fe from contaminating sources appeared to have increased.

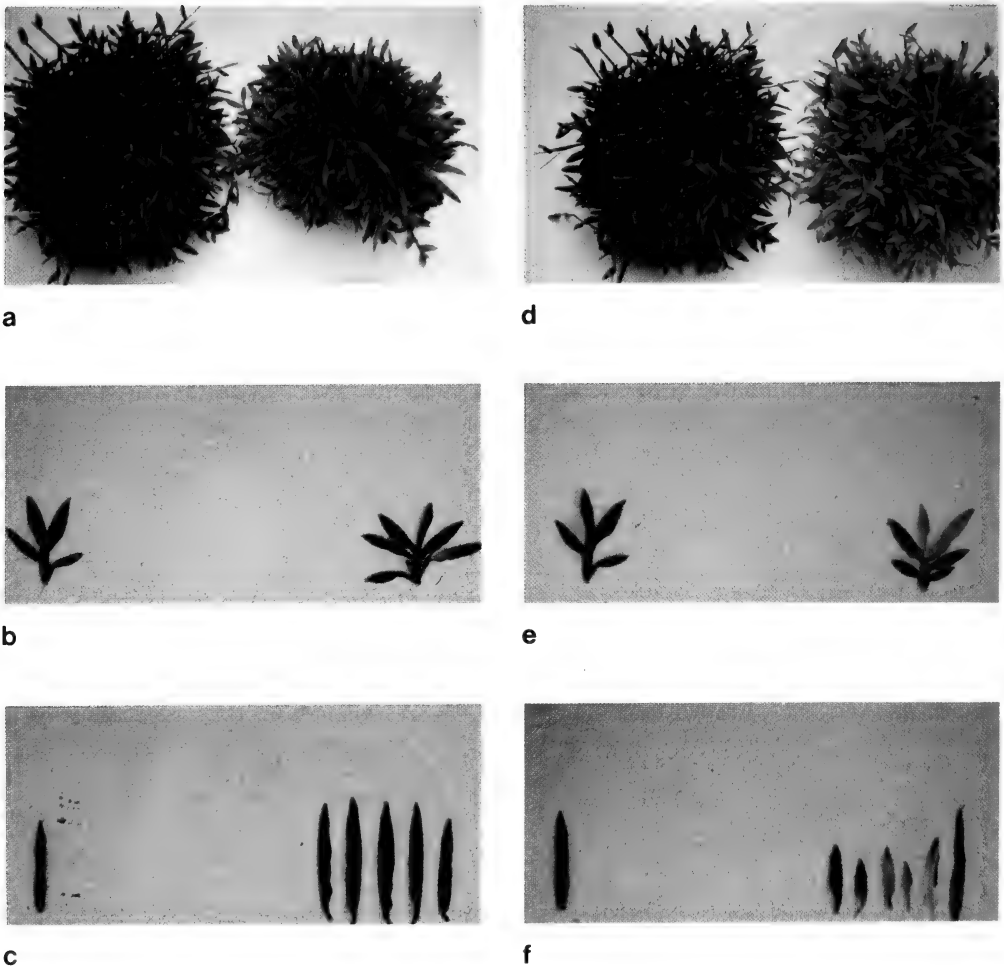


Plate 3. Deficiency symptoms : Top

Treatment 5 : a – c
a = Top view : control (left), Magnesium-deficient (right)
b = Tiller : control (left), Magnesium-deficient (right)
c = Sequence of symptom development : control (left), Magnesium-deficient (right)

Treatment 6 : d – f
d = Top view : control (left), Iron-deficient (right)
e = Tiller : control (left), Iron-deficient (right)
f = Sequence of symptom development : control (left), Iron-deficient (right)

colouration of blades and some reductions in dry-matter production, particularly of the root system, the deficiencies in the macro elements N and P, however, led to marked reductions in both tiller and root growth, inflorescence production, and to various discolourations of blades in *Axonopus compressus*. The deficiency symptom of K became evident only 10 weeks after treatment. From the intensity of symptom manifestation after 3 months, it is reasonable to speculate further reduction in growth if the trial were continued.

The experimental iron deficiency symptoms resembled the symptom developed by *Axonopus compressus* thriving on over-limed areas where the pH is 7.0 and above. A liming trial will be conducted to confirm the present observations. The present finding cautions the free-handed use of lime for *Axonopus compressus* substrates. Liming is best guided by soil analysis.

Acknowledgement

The authors wish to thank Mr A. K. Wan, the Department Artist, for taking the photographs.

References

Anonymous. 1977. *A handbook on the maintenance of school fields.* An information booklet published by the Parks & Recreation Department, Singapore.

Asher, C.J. 1973. *Lecture and practical notes for short courses in applied plant nutrition.* Nanyang University, Singapore.

Beard, J.B. 1973. Turfgrass : *Science and culture.* Prentice-Hall, Englewood Cliffs, and references therein.

Beard, J.B. 1979. *How to have a beautiful lawn – Easy steps in turfgrass establishment and care for aesthetic and recreational purposes.* 2nd edition. Beard Books, Ohio.

Chai, B.F. 1978. A study of the mineral deficiency and nitrate assimilation in Choy Sam (*Brassica chinensis*). Master's Thesis, Department of Biology, Nanyang University, Singapore.

Gilliland, H.B. 1953. *A revised Flora of Malaya.* Volume III. *Grasses of Malaya,* p. 187. The Government Printing Office, Singapore.

Madison, J.H. 1971. *Principles of turfgrass culture.* Van Nostrand Reinhold, New York.

Oertli, J.J. 1973. Nutrient disorders in turfgrass. *California Turfgrass Culture,* Vol 3, No. 3, 17-19. (cited by Beard, 1973).

Vengris, J. 1973. *Lawns : Basic factors, construction and maintenance of fine turf areas.* 2nd edition. Thomson, Indianpolis.

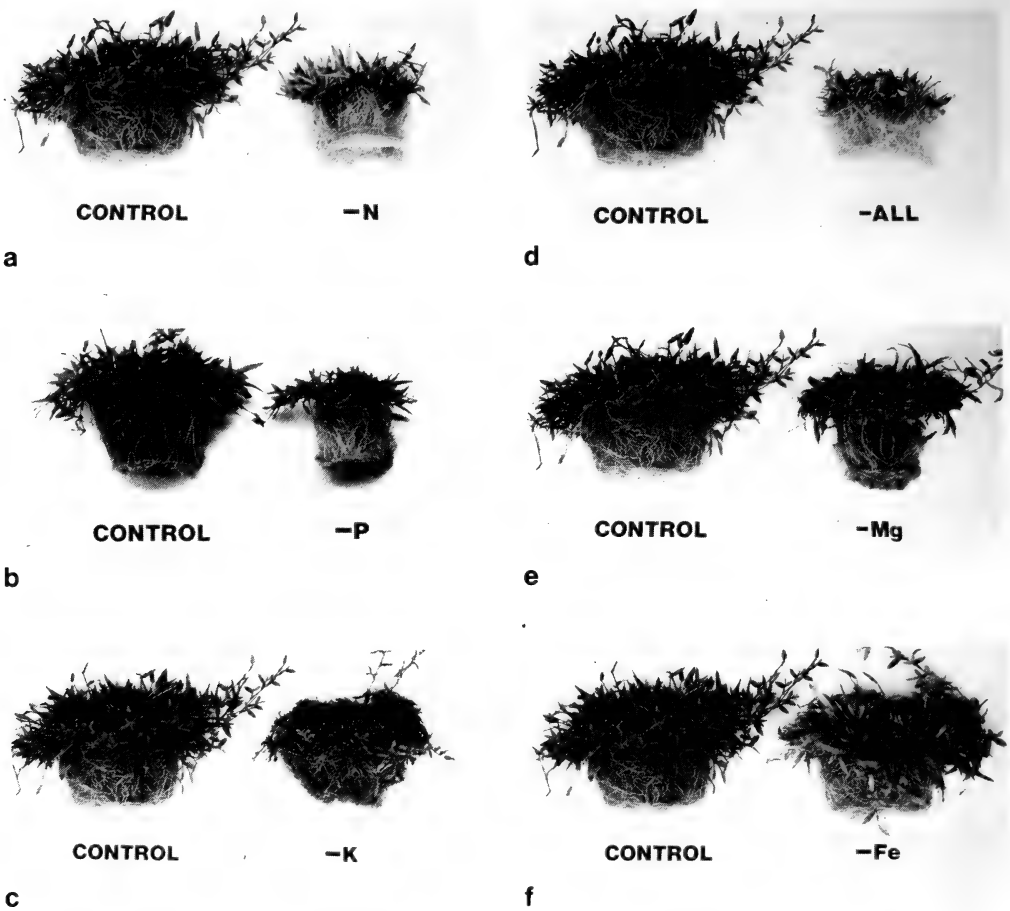


Plate 4. Deficiency symptoms : Root system

a (Treatment 1) = control (left), Nitrogen-deficient (right)
b (Treatment 2) = control (left), Phosphorus-deficient (right)
c (Treatment 3) = control (left), Potassium-deficient (right)
d (Treatment 4) = control (left), minus all (right)
e (Treatment 5) = control (left), Magnesium-deficient (right)
f (Treatment 6) = control (left), Iron-deficient (right)

APPENDIX 1 : Formulations for Stock Solutions and Nutrient Solutions

Stock solution	Control (ml)	–N (ml)	–P (ml)	–K (ml)	–Ca (ml)	–Mg (ml)	–Fe (ml)	–S (ml)	Weight of salt (g)	Volume (ml)
1M $Ca(NO_3)_2.4H_2O$	10	–	10	10	–	10	10	10	472.00	2,000
1M KNO_3	10	–	10	–	10	10	10	10	202.00	2,000
0.2M KH_2PO_4	10	10	–	–	10	10	10	10	54.40	2,000
1M $MgSO_4.7H_2O$	4	4	4	4	4	–	4	–	247.00	1,000
1M $NaNO_3$	–	–	–	10	20	–	–	–	128.00	1,500
1M $CaCl_2$	–	10	–	–	–	–	–	–	56.00	500
1M KCl	–	10	1	–	–	–	–	–	39.30	500
1M $MgCl_2.6H_2O$	–	–	–	–	–	–	–	4	40.70	200
1M Na_2SO_4	–	–	–	–	–	4	–	–	28.40	200
1M $NaH_2PO_4.2H_2O$	–	–	–	1	–	–	–	–	31.20	200
$(CH_2N(CH_2.COO)_2)_2FeNa$	2	2	2	2	2	2	–	2	41.70	500
H_3BO_3	2	2	2	2	2	2	2	2	1.43	500
$MnSO_4.H_2O$	2	2	2	2	2	2	2	2	2.00	500
$ZnSO_4.7H_2O$	2	2	2	2	2	2	2	2	1.15	500
$CuCl_2.2H_2O$	2	2	2	2	2	2	2	2	0.26	500
$(NH_4)_6Mo_7O_{24}.4H_2O$	2	2	2	2	2	2	2	2	0.02	500

Notes

1. All chemicals used were analar grade.
2. For the individual trace elements, the formulation for the control excluding the trace element in question was used.
3. All the above formulations were made up to 3 litres before application.

Appendix 2 : Concentration of individual mineral elements in nutrient solutions

Nutrient solution														
	N	**P**	**K**	**Ca**	**Mg**	**Fe**	**S**	**B**	**Mn**	**Zn**	**Cu**	**Mo**	**Na**	**Cl**
Control (complete)	139.9	20.6	156.3	133.3	32.5	8.5	43.50	0.33	0.87	0.43	0.15	0.015	3.5	0.11
–N	0	20.6	163.1	134.5	32.5	8.5	43.50	0.33	0.87	0.43	0.15	0.015	3.5	239.11
–P	139.9	0	143.9	133.3	32.5	8.5	43.50	0.33	0.87	0.43	0.15	0.015	3.5	12.61
–K	140.1	10.3	0	133.3	32.5	8.5	43.50	0.33	0.87	0.43	0.15	0.015	88.2	0.11
–Ca	140.2	20.6	156.3	0	32.5	8.5	43.50	0.33	0.87	0.43	0.15	0.015	157.5	0.11
–Mg	139.9	20.6	156.3	133.3	0	8.5	42.70	0.33	0.87	0.43	0.15	0.015	64.8	0.11
–Fe	139.9	20.6	156.3	133.3	32.5	0	43.50	0.33	0.87	0.43	0.15	0.015	0	0.11
–S	139.9	20.6	156.3	133.3	32.4	8.5	0.67	0.33	0.87	0.43	0.15	0.015	3.5	94.91
–B	139.9	20.6	156.3	133.3	32.5	8.5	43.50	0	0.87	0.43	0.15	0.015	3.5	0.11
–Mn	139.9	20.6	156.3	133.3	32.5	8.5	42.96	0.33	0	0.43	0.15	0.015	3.5	0.11
–Zn	139.9	20.6	156.3	133.3	32.5	8.5	43.50	0.33	0.87	0	0.15	0.015	3.5	0.11
–Cu	139.9	20.6	156.3	133.3	32.5	8.5	43.50	0.33	0.87	0.43	0	0.015	3.5	0
–Mo	139.9	20.6	156.3	133.3	32.5	8.5	43.50	0.33	0.87	0.43	0.15	0	3.5	0.11

A Check-list of the Memecylon Species (Melastomataceae) in Borneo, Java, Malaya and Sumatra

KÅRE BREMER
Section of Phanerogamic Botany, Swedish Museum of Natural History, Stockholm

Abstract

An annotated list of 43 species of *Memecylon* is presented. It is based on recent revisions from Malaya and Borneo by J. F. Maxwell and K. Bremer, respectively. All *Memecylon* taxa (except *M. oligoneurum* with its synonyms, which has been transferred to the genus *Lijndenia*) described or reported from the four areas are referable to the 43 species listed.

Introduction

Memecylon is a palaeotropical genus of small to medium-sized trees or shrubs, commonly occurring in tropical evergreen forests. The genus has recently been revised by Maxwell (1980 a, b) in the Malay Peninsula (= Peninsular Malaysia) and by Bremer (1982 b) in Borneo. Many of the Malayan and Bornean species occur also in Java and Sumatra and the present paper is intended to bring the taxonomy of *Memecylon* from these areas up to date.

In a few cases the treatments by Maxwell and Bremer differ. *M. globosum* Bakh. f. is reduced by Bremer to a synonym of *M. durum* Cogn, and *M. beccarianum* Cogn. is reduced to that of *M. acuminatissimum* Bl. The latter species is considered by Bremer distinct from *M. oleifolium* Bl. Maxwell considers *M. ovatum* Sm. a variety of *M. edule* Roxb., whereas Bremer keeps them separate. The species commonly known as *Memecylon oligoneurum* Bl. has recently been transferred by Bremer (1982 a) to a separate genus, *Lijndenia,* and named *L. laurina* Zoll. & Mor. It differs from *Memecylon* e.g. by its 3-nerved leaves. *Memecylon oligoneurum* is *Lijndenia laurina* and therefore excluded from the list.

The *Flora of Java* by Backer and Bakhuizen f. (1963) is recommended for identification of *Memecylon* species from that area. Some of the species have been reduced to synonymy by Maxwell and the following name changes should thus be noted: *M. ambiguum* Bl. = *M. oleifolium* Bl., *M. depokkense* Bakh. f. = *M. fruticosum* King, *M. floribundum* Bl. = *M. coeruleum* Jack, *M. myrsinoides* Bl. = *M. lilacinum* Zoll. & Mor., and *M. pseudo-nigrescens* Bl. = *M. lilacinum* Zoll. & Mor. Furthermore, it should also be noted that not only *M. edule* Roxb. var. *ovatum* (Sm.) C.B. Cl. (here considered a separate species) but also *M. edule s. str.* occur in Java.

Many species are common to Sumatra and Malaya and Maxwell's revision is recommended for their identification for both areas. There are also four species described from Sumatra but not reported for Malaya and thus not included in Maxwell's revision. These are *M. laruei* Merr., *M. ochroleucum* Bakh. f., *M. subcordifolium* Bakh. f., and *M. sumatrense* Bakh. f. and they are commented upon below.

In the list of species below, the distribution is indicated immediately after each name by the letters B, J, M and S, representing Borneo, Java, Malaya and Sumatra, respectively. Synonyms are given in those cases where there are differences between the *Flora of Java* on the one hand and Maxwell's and Bremer's revisions on the other. The others, from earlier literature, including the extensive work by Bakhuizen f. (1943), have been included in the latter two treatments. Thus all *Memecylon* taxa (except *M. oligoneurum* Bl. and its synonyms) hitherto described or reported from the four areas are now referable to the 43 species included in the list. Of these there are 27, 12, 29 and 18 species recorded from each of the four areas Borneo, Java, Malaya and Sumatra, respectively.

List of Memecylon Species from Borneo, Java, Malaya and Sumatra

M. acuminatissimum Bl. (*M. beccarianum* Cogn.) – B M S
M. acuminatissimum was described from Sumatra and Maxwell united it with *M. oleifolium* but kept separate *M. beccarianum,* described from Borneo. Bremer, however, retained *M. acuminatissimum* and *M. oleifolium* as separate species, and reduced *M. beccarianum* to a synonym of *M. acuminatissimum.*

M. acuminatum Sm. – M

M. amplexicaule Roxb. – B M

M. argenteum Bremer – B

M. borneense Merr. – B

M. calyptratum Bremer – B

M. campanulatum C.B. Cl. – B M S

M. cantleyi Ridl. – B M S

M. cinereum King – M

M. coeruleum Jack (*M. floribundum* Bl.) – J M S

M. confertiflorum Cogn. – B

M. corticosum Ridl. – B M

M. dichotomum C. B. Cl. – M

M. durum Cogn. (*M. globosum* Bakh. f.) – B M

M. edule Roxb. – B J M S

M. excelsum Bl. – B J M S

M. floridum Ridl. – B M

M. fruticosum King (*M. depokkense* Bakh. f.) – B J M S

M. garcinioides Bl. – B J M S

M. gibbosum Bakh. f. – J

This species was described because of its basally and unilaterally gibbous fruits. Such asymmetric fruits are known to occur in several species of *Memecylon,* however. In other characters *M. gibbosum* is similar to *M. edule.* Its specific status needs further investigation.

M. hullettii King – M

M. intermedium Bl. – B J M S

M. kunstleri King – M

M. lancifolium Ridl. – M
This is an insufficiently known species. It seems to be related to *M. acuminatissimum* or *M. oleifolium.*

M. laruei Merr. – S
This characteristic species endemic to Sumatra is illustrated in Fig. 1.

M. lilacinum Zoll. & Mor. (*M. myrsinoides* Bl., *M. pseudo-nigrescens* Bl.) – B J M S
There are two varieties placed as unknown by Bakhuizen f. (1943 p. 367), *M. myrsinoides* var. *latifolia* Koord. & Val. (*M. "intermedium"* var. *latifolia sphalm.*) and *M. myrsinoides* var. *subquadrialata* Miq. (*M. myrsinoides* var. *"quadrialata" sphalm.*) Both belong under *M. lilacinum.* They are characterized by broad leaves and quadrangular branchlets, respectively, but this is a normal variation within this species and taxonomic recognition is thus necessary.

M. longifolium Cogn. – B

M. malaccense (C.B. Cl.) Ridl. – M

M. megacarpum Furtado – B M

M. minutiflorum Miq. – B M S

M. monchyanum Backer – J
This species, illustrated in Fig. 1, is endemic to Java.

M. ochroleucum Bakh. f. – S
This is an insufficiently known species. It is characterized by its leaves which dry pale yellowish brown to green. The inflorescences have well developed peduncles.

M. oleifolium Bl. (*M. ambiguum* Bl.) – B J M S
M. horsfieldii Miq., described from Sumatra and listed as unknown by Bakhuizen f. (1943 p. 367), is here reported as a synonym. The type collected by Horsfield is at Utrecht.

M. ovatum Sm. (*M. edule* Roxb. var. *ovatum* (Sm.) C.B. Cl.) – B J M S

M. paniculatum Jack – B J M S

M. pauciflorum Bl. – M

M. pergamentaceum Cogn. – B

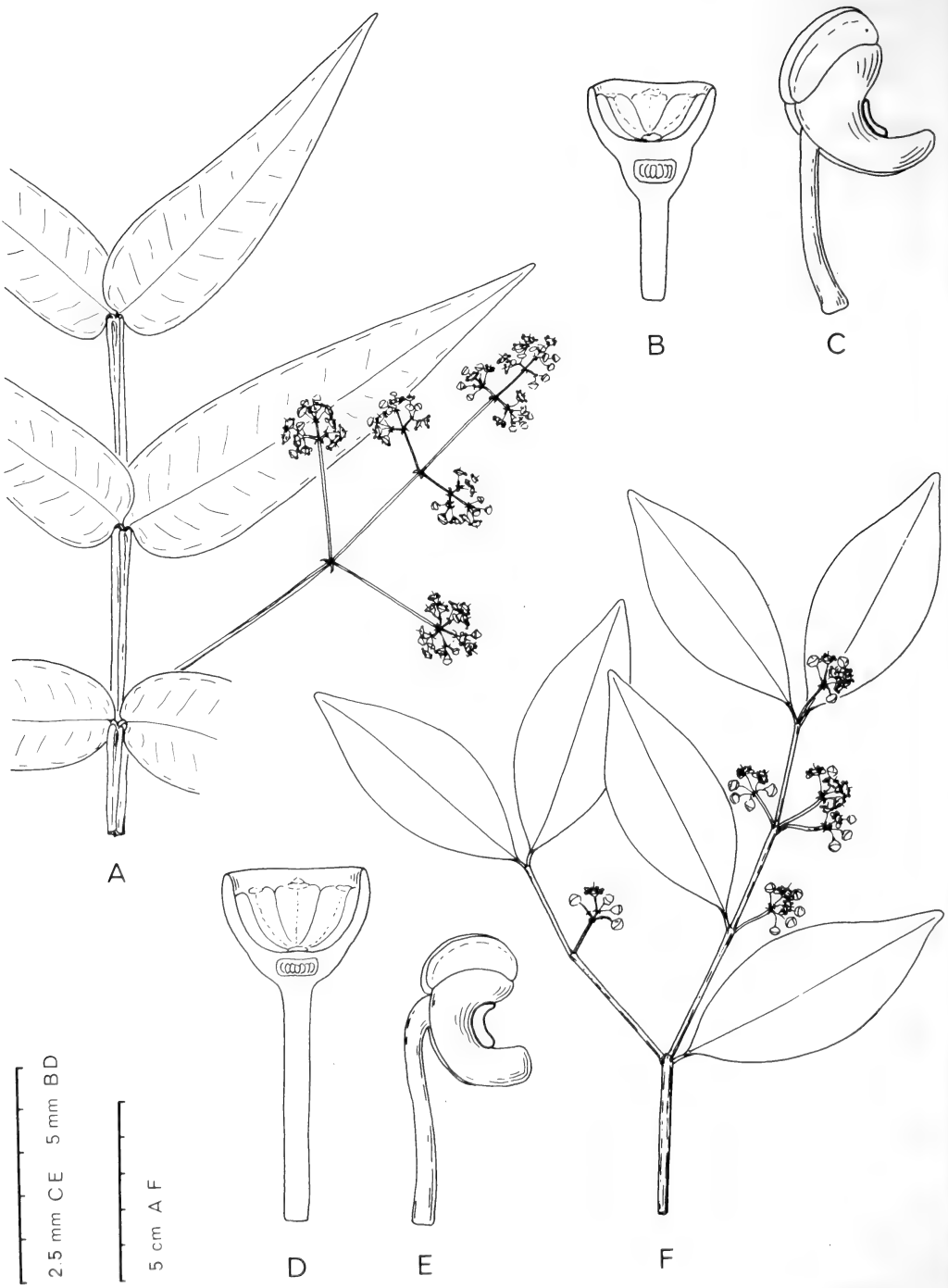


Fig. 1. *Memecylon laruei* Merr. (A-C) and *Memecylon monchyanum* Backer (D-F). A, F: Flowering branches. B, D: Section through flowers with petals, stamens, and style removed. C, E: Stamens. A-C: *De Wilde* and *De Wilde-Duyfjes 14662*. D-F: *Zollinger 3914*.

M. pubescens (C.B. Cl.) King – B M

M. ruptile Bremer – B

M. scolopacinum Ridl. – B

M. subcordifolium Bakh. f. – S
This species is similar to *M. paniculatum* but differs by its terete branchlets.

M. sumatrense Bakh. f. – S
This species is clearly related to *M. pubescens* but differs in its longer petioles.

M. wallichii Ridl. – M

References

Backer, C. A. & R. C. Bakhuizen van den Brink (fil.) 1963. *Flora of Java* 1. Groningen.

Bakhuizen van den Brink, R. C. (fil.) 1943. A contribution to the knowledge of the Melastomataceae occurring in the Malay archipelago especially in the Netherlands East Indies. *Rec. Trav. Bot. Neerl.* 40, *Meded. Bot. Mus. Herb. Rijksuniv. Utrecht* 91: 1-391.

Bremer, K. 1982 a. *Lijndenia,* a re-established paleotropical genus of the Melastomataceae-Memecyleae. *Nord. J. Bot.* 2: 121-124.

Bremer, K. 1982 b. Taxonomy of *Memecylon* (Melastomataceae) in Borneo. *Opera Bot.*

Maxwell, J. F. 1980 a. Revision of *Memecylon* L. (Melastomataceae) from the Malay Peninsula. *Gard. Bull. Singapore* 33: 31-150.

Maxwell, J. F. 1980 b. Synopsis of *Memecylon* L. (Melastomataceae) in the Malay Peninsula. *Malayan Nat. J.* 34: 7-24.

Preliminary Findings on the Biology of *Autoserica rufocuprea* (Blanchard) *sensu* Brenske (Coleoptera: Melolonthinae) in Singapore

CHOO-TOH GET TEN
Botanic Gardens, Singapore

Abstract

Autoserica rufocuprea, a species of Melolonthinae and a night flying beetle, has been found to attack many ornamental plants and shade trees in Singapore. Thirty two species of its food plants were revealed by field observations at night. A survey showed that in a park developed on clayey reclaimed land, about 8% of the total plant population was damaged. The level of infestation of the beetle in different parts of the park and the susceptibility of its host plants are discussed. The damage patterns made on plants, and preliminary observations on the life cycle and seasonal flights of the beetle are briefly described.

Introduction

The cockchafers, which include night-feeding beetles in the subfamilies Rutelinae and Melolonthinae (Dammerman, 1929), have long been known to be serious plant pests in many parts of the world including Southeast Asia. According to various reports, many economic crops, some forest trees, shade trees, turf and pastures have been damaged (Swaine, 1971; Britton, 1979; Borror & Delong, 1966; Ritcher, 1966). Some ornamental plants have also been named as host plants (Dammerman, 1929; Yunus & Ho, 1980).

In Singapore it had often been observed that many ornamental plants and shade tree saplings suffered serious foliar damage similar to those made by a few species of cockchafers on economic crops (Kalshoven, 1951; Lever, 1953). Studies were therefore carried out from November 1979 to February 1980 by the Entomology Unit of Parks & Recreation Department to confirm these suspected pest attacks. The host range of these night flying beetles at Botanic Gardens & East Coast Park was investigated. The extent and severity of damage made on plants at East Coast Park was also assessed. Subsequently, laboratory studies and field observations were conducted to gather more information about the life cycle and seasonal flights of these beetles. This paper reports the findings and preliminary observations made by the author on *Autoserica rufocuprea,* one of the cockchafers.

Study Sites

The surface area of the Botanic Gardens (BG) is about 32 hectares. Apart from the orchids and the plants in the Gardens' jungle, it accommodates nearly a thousand species of native and introduced plants scattered over some 20 lawns. Most of these species are represented by only one to a few individuals. The garden was first established in 1859 and most of the trees here are old.

The East Coast Park (ECP) is a park newly developed on clayey reclaimed land. It has about 100 hectares of green area, which were planted up between 1973 and 1978. It is divided by monsoon drains into 6 sections, namely areas E, C, D, B, A, F and AA, listed in chronological sequence of development. A peculiar feature of the park was that certain areas, namely areas F, E and parts of AA were often waterlogged due to poor drainage. At the time the studies began, the park had about a hundred species of plants. These included mainly ornamental and shade trees and some shrubs. Here plants of the same species mostly occur in distinct stands which vary from a few to hundreds in number.

Materials and Methods

1. *Collection of the cockchafers*

The adult cockchafers are known to shelter in the soil during day time and only emerge after sunset. Therefore most collections were obtained between 7.00pm and 10.30pm. The cockchafers on host plants were revealed in torch light. They were either picked by hand or shaken directly into plastic bags or vials.

In day time, the grubs, pupae and adults were obtained by digging into the turfed areas near the host plants.

2. *Identification of A. rufocuprea*

The pinned adults were sent to the Commonwealth Institute of Entomology and the National University of Singapore for identification.

3. *Survey on host plants*

The host plants of *A. rufocuprea* and the damaged plant parts were observed at the two study sites at night. The damage patterns made on host plants were also carefully noted during the visits.

4. *Survey on pest status of A. rufocuprea at ECP*

The two aspects of the survey were the relative infestation levels of *A. rufocuprea* in different areas of ECP and the extent of damage made on individual species of host plants. The entire park was systematically combed for 3 months starting from mid-November 1979 so that all the plants were examined as far as possible.

At each area of ECP, records were made of the number of plants examined, which also was, or almost equalled, the total plant population of the area. The total number of host plants and of those with typical damage symptoms were also noted. The percentage of plants attacked in each area was then worked out. These percentages were used to indicate the relative level of infestation of *A. rufocuprea* in the different areas.

The extent of damage made on 19 species of host plants was quantified by two indices, namely the % incidence of attack and the severity of damage.

The % incidence of attack of any species is determined by the formula :

$$\frac{\text{No. of plants (of the species) attacked}}{\text{No. of plants (of the species) examined}} \times 100\%$$

The severity of damage was a visual assessment of the percentage of the foliage or canopy of a plant eaten up by the insect. It was arbitrarily categorised into 5 degrees, as follows:

% of foliage eaten	*Severity of damage*	*Denotation*
<10%	very slight	+
10 – 30%	slight	++
31 – 50%	moderate	+++
51 – 70%	severe	++++
>70%	very severe	+++++

The severity of damage given in the results for a particular species of plant is the assessment rated for the majority of plants examined.

5. *Observations on life-cycle and seasonal flights*

The adults collected during the mating season were reared at room temperature (about 28°C) in rectangular perspex cages. Each cage measures 50 x 50 x 60 cm and has one side made of white organdi. Young *Peltophorum pterocarpum* (DC.) K. Heyne seedlings grown in polythene bags were placed in the cage as food plants. The soil in the polythene bags was checked for the presence of eggs at intervals of 3 to 4 days. The eggs and newly hatched grubs were transferred to small bottles containing soil and vegetative litter. The grubs were later reared on roots of cowgrass in pots until they pupated. The pupae were kept in bottles filled with slightly moist soil until they hatched into adults.

The seasonal flight periodicity of *A. rufocuprea* was determined by monthly visits of ECP at night, the duration of the study being from February, 1981 to April, 1982. When the population was high, visits were conducted more frequently, at fortnightly or weekly intervals. During each visit the abundance of the beetles on the host plants was noted and their mating activities were observed.

Results & Discussions

1. *The identification of A. rufocuprea*

The cockchafer under study was identified by the Commonwealth Institute of Entomology as *Maladera* sp. It was later identified by Mr. D.H. Murphy of the National University of Singapore as *Autoserica rufocuprea* (Blanchard) *sensu* Brenske 1894. He believes this to be of the same species as one recorded from Ceylon but in the British Museum, it is placed under *Aserica mollis* (Walker).

It appears that the controversy over the placing of this insect under the genera *Autoserica, Maladera,* or *Aserica* is merely a matter of difference of opinion. Kalshoven (1951), for instance, had included *Aserica, Autoserica* and *Microserica* in his description of the genus *Serica.*

2. *Damage patterns and feeding habits*

A. rufocuprea often feeds gregariously (Pl. 1). This can lead to severe defoliation of saplings or new transplants bearing new leaves (Pl. 2). Leaves which are many

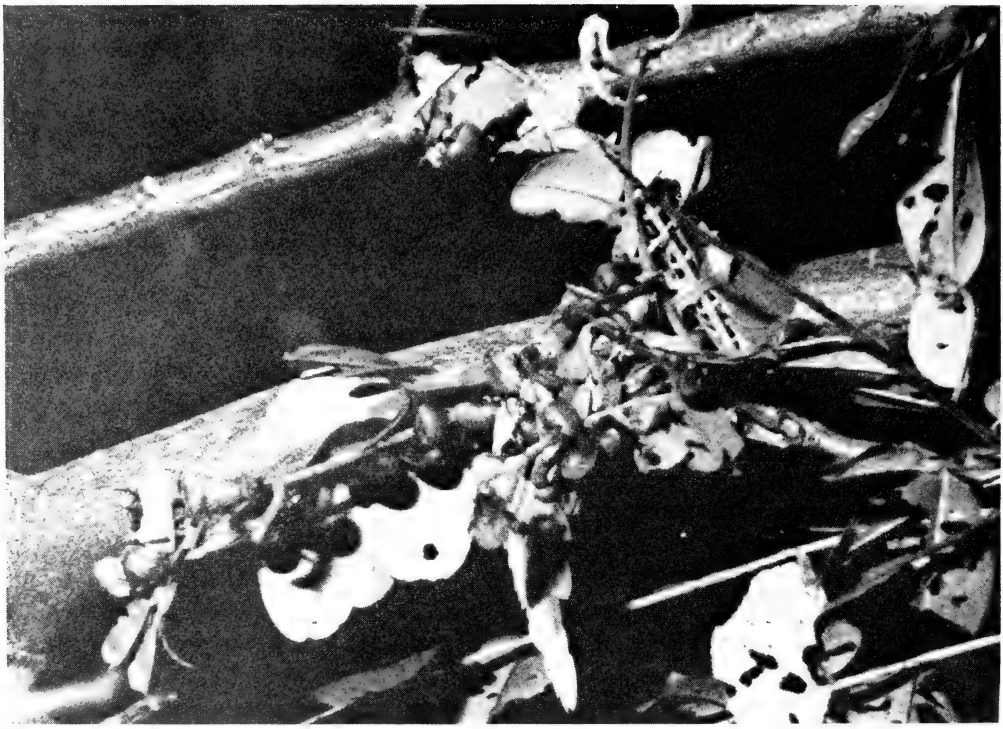


Plate 1. *Autoserica rufocuprea* feeding gregariously on leaves of *Cassia nodosa.*

Plate 2. Branches of *Cassia nodosa* defoliated by *Autoserica rufocuprea.*

Plate 3. Leaves of young *Gardenia carinata* skeletonised by *Autoserica rufocuprea.*

Plate 4. Leaves of *Erythrophleum suaveolens* with gnaw-marks of *Autoserica rufocuprea.*

times the size of the beetle can be skeletonised to side veins or just the midrib (Pl. 3). Those less severely attacked will have big, irregular cuts at the leaf edges (Pl. 4). Flower petals and buds can also be badly gnawed (Pl. 5). The damage pattern on individual leaves is quite similar to that caused by *Apogonia cribricollis* Burm., another Melolonthinae (Lever, 1953); it is quite distinct from that caused by species of *Adoretus,* a Rutelinae, which make holes in leaves (Kalshoven, 1951).

A. rufocuprea has the habit of clinging to the edges of leaves while feeding; but it would drop instantly to the ground at the slightest touch of the leaf on which it is feeding. It would respond in similar fashion while being approached or shone on abruptly. Occasionally, female *A. rufocuprea* may be seen to feed whilst mating (Pl. 6).

A. rufocuprea only damages young, tender leaves in contrast with *Adoretus compressus* Weber which feeds on older leaves. The difference in their food preference could be the reason why *A. rufocuprea* and *A. compressus* can co-exist in the same location and can sometimes be found on the same plant, though seldom on the same leaf.

3. *Host plants*

Table 1 lists the host plants of *A. rufocuprea* at ECP and BG.

Of these, 26 species were recorded at ECP and 12 species at BG. Many of the host plants at BG are not attacked because they do not occur in pure stands which provide ample food for the pest, unlike those at ECP. Moreover, the much more complex ecological community at BG has attained a stable equilibrium which resists the build up of a high population of any single insect species.

On all except five of the listed plants, actual feeding by the beetle had been observed. On the exceptional five species, very few symptoms of foliar damage were observed, the beetle being seen resting only on the plants.

Table 1 also shows that the beetle feeds mainly on the leaves and occasionally on flowers. The species of plants found with the flowers damaged are *Acacia auriculaeformis, Ixora finlaysoniana, Saraca thaipingensis, Bauhinia purpurea* and *Tabebuia pallida.*

4. *Level of infestation of A. rufocuprea at different areas of ECP*

Table 2 shows that 8.0% of the total plant population at ECP was attacked by *A. rufocuprea.* Columns (d) and (e) in the table also indicate the percentages of total plant population and host plant population which were attacked at different areas in ECP. Based on a comparison of the percentages of plants attacked in the various areas, A could be considered to be more highly infested with *A. rufocuprea* than AA and B, and C, D, E and F were comparatively lightly infested.

Observations of the different areas at night also revealed that the *A. rufocuprea* population was high in areas A, B and AA, and low in the others. The beetle popula-

Table 1.
Host plants of *A. rufocuprea* at East Coast Park and Botanic Gardens

Host plant	*Location*	*Parts damaged*	*+ Date observed*
Acacia auriculaeformis Bth.	ECP	Flowers	Sept. 81
Actinorhytis calapparia (Bl.) Scheff.	BG	*	
Andira inermis (Wight) HBK	ECP	Leaves	
Antidesma bunius (L.) Spreng.	ECP	Leaves	
Bauhinia purpurea L.	ECP	Leaves, Flowers	Apr. 82
Canna Primrose	BG	*	
Cassia fistula L.	ECP	*	Apr. 82
C. nodosa Roxb.	ECP	Leaves	Jul. 81
C. spectabilis DC.	ECP	Leaves	
Cochlospermum religiosum (L.) Aston	ECP	*	
Cola acuminata (Beauv.) Schott & Endl.	BG	Leaves	
Delonix regia (Hk.) Raf.	ECP	Leaves	
Erythrina fusca Lour.	ECP	Leaves	
E. variegata L.	ECP	Leaves	
Erythrophleum suaveolens (Guill. & Perr.) Bren.	ECP	Leaves	
Eucalyptus pellita F. Muell.	BG	Leaves	
Eugenia grandis Wight	ECP	Leaves	Feb. 81
E. polyantha Wight	ECP	Leaves	
Gardenia carinata Wall.	ECP	Leaves	
Hopea sangal Korth.	BG	*	
Ixora finlaysoniana G. Don.	BG	Flowers	
I. javanica DC.	BG	Leaves	
Kopsia flavida Bl.	ECP	Leaves	
Lagerstroemia speciosa Pers.	ECP, BG	Leaves	
Milletia atropurpurea (Wall.) Benth	ECP, BG	Leaves	
Paulownia taiwaniana Hu & Chang	BG	Leaves	
Peltophorum pterocarpum (DC.) K. Heyne	ECP	Leaves	
Pterocarpus indicus Willd.	ECP	Leaves	
Samanea saman (Jacq.) Merr.	ECP	Leaves	
Saraca thaipingensis Prain	BG	Leaves, Flowers	
Stereospermum fimbriatum DC.	ECP	Leaves	
Tabebuia pallida (Lindl.) Miers	ECP	Leaves, Flowers	
Tabebuia rosea (Bertol) DC.	ECP	Leaves	
Tamarindus indicus L.	ECP	Leaves	
Terminalia catappa L.	ECP	Leaves	Feb. 82
Warszewiczia coccinea Klotzsch	BG	Leaves	

* *A. rufocuprea* was only seen resting on this species, no feeding was observed.

\+ Where unstated, date observed is November–December 1979.

tion was generally high where the host plants were young and where the activities of the beetle were least disturbed by nocturnal park users, and, it seemed low where the area was frequently waterlogged, e.g. at area F.

As it is neither entirely satisfactory to relate pest population to the level of pest damage (Southwood, 1966) nor to assess pest population visually, future assessment of the pest infestation level is best determined with methods like trapping and sampling of pest populations from plants.

Table 2
The number of plants in different areas of East Coast Park with the number and percentage attacked by *A. rufocuprea* indicated.

*Area**	*(a) Total plant population*	*(b) Host-plant population*	*(c) No. of host plants attacked*	*(d) % of plants attacked* $\frac{c}{a} \times 100\%$	*(e) % of host plants attacked* $\frac{c}{b} \times 100\%$
AA	544	99	59	10.8	59.6
F	679	142	29	4.3	20.4
A	2,757	589	399	14.5	67.7
B	2,829	627	259	9.1	41.3
D	3,980	1,722	250	6.2	14.5
C	3,274	881	187	5.7	21.2
E	3,158	744	194	6.1	26.1
Total	17,221	4,804	1,377	8.0	28.6

* The areas are listed in time sequence of development. AA is the most recently planted area.

5. *Extent of damage on the host plants at ECP*

Table 3 indicates the extent of damage made by *A. rufocuprea* on 19 species of host plants at ECP in terms of % incidence of attack and severity of damage.

Of the listed plants, 5 species were localised in only one or two areas of ECP. Of these 5 species, *Antidesma bunius* and *Cassia spectabilis* were located only in area A. Since the pest population was high in area A and the plants here were young, the % incidence of attack of these 2 species were very high.

Considering the pest population at the location of the trees together with the severity of damage and % incidence of attack, *Gardenia carinata* is probably only slightly less susceptible than *A. bunius,* but *Erythrina fusca* could be as vulnerable as or even more vulnerable than *A. bunius* because it was extensively and severely damaged despite the fact that it was located outside highly infested areas. Of the 5 species, *Erythrina variegata* was most resistant to the beetle attack.

Table 3.

The extent of damage made by *A. rufocuprea* on 19 species of host plants at East Coast Park in term of % incidence of attack and severity of damage

Host species	Areas			Number of plants damaged/examined	% incidence of attack	Severity of damage
	highly infested	moderately infested	lightly infested			
*1. *Antidesma bunius* (L.) Spreng.	A	–	–	10/10	100	++++
2. *Cassia spectabilis* DC.	A	–	–	15/16	93.7	++
3. *Erythrina fusca* Lour.	–	–	C,E	24/26	92.3	+++
4. *E. variegata* L.	–	B	D	7/29	24.1	+
5. *Gardenia carinata* Wall.	A	–	C	41/53	77.3	+++
+6. *Andira inermis* (Wight) HBK	A	AA, B	C,D,E,F	30/337	8.9	+
7. *Delonix regia* (Hk.) Raf.	A	B	C,D,E	5/51	9.8	+
8. *Eugenia polyantha* Wight	A	B	C,D	99/460	21.5	++
9. *Erythrophleum suaveolens* (Guill. & Perr.) Bren.	A	–	C,E	28/113	24.7	++
10. *Samanea saman* (Jacq.) Merr.	A	AA, B	D,E	193/1474	13.1	++
11. *Kopsia flavida* Bl.	A	B	C	81/97	83.5	++
12. *Lagerstroemia speciosa* (L.) Pers.	A	B	C,E	43/54	79.6	++
13. *Milletia atropurpurea* (Wall.) Benth.	A	AA, B	C,D	66/173	38.1	+
14. *Peltophorum pterocarpum* (DC.) K. Heyne	A	B	C,D,E,F	158/502	31.4	++++
15. *Pterocarpus indicus* Willd.	A	AA, B	C,D,F	191/712	26.8	+++
16. *Stereospermum fimbriatum* DC.	A	AA, B	C,D,E	108/143	75.5	++
17. *Tabebuia pallida* (Lindl.) Miers	A	AA, B	C,D,E,F	98/148	66.2	+++
18. *Tabebuia rosea* (Bertol.) DC.	A	AA, B	C,D,E,F	253/331	76.4	+
19. *Tamarindus indicus* L.	A	AA	C,D,E,F	33/67	49.2	++
Severity of damage % of foliage damaged	+ <10%	++ 10% – 30%	+++ 31% – 50%	++++ 51% – 70%	+++++ > 70%	

* species no. 1–5 are localised in one or two areas of ECP
\+ species no. 6–19 are well dispersed throughout ECP

Of the remaining 14 host species which were well dispersed throughout ECP, *Andira inermis* and *Delonix regia* were only slightly affected by *A. rufocuprea*. Compared to them, *Eugenia polyantha, Erythrophleum suaveolens, Samanea saman, Milletia atropurpurea* and *Tamarindus indicus* were more prone to attack. Species like *Kopsia flavida, Lagerstroemia speciosa, Stereospermum fimbriatum* and *Tabebuia rosea* had an even higher percentage incidence of attack although the degree of damage was generally slight. The three species of plants that were very severely damaged when they had plenty of young flushes were *Peltophorum pterocarpum, Pterocarpus indicus* and *Tabebuia pallida.*

6. *Life cycle*

The eggs are laid in groups within a hollow surrounded by compacted clayey soil (Pl. 7). They are found at a depth of 1½ to 2 inches. When laid under laboratory conditions, each group of eggs varies from three to six in number. Each egg is white and elongate-oval in shape, measuring 1.2 mm to 1.4 mm in length and about 1.0 mm in breadth. As the embryo develops, the egg turns creamy in colour and swells slightly.

The larva hatches in about a week. It is initially white and 2 mm long. As the grub grows, its body becomes creamy in colour while the mandible turns yellowish. The length of the full-grown larva (Pl. 8) is about 19 mm. The entire larval period lasts about 10 weeks. The prepupal and pupal stages last about 11 days. The pupa is ivory coloured and often has a lump of earth attached to the abdomen (Pl. 9). The total period of development from the time eggs are laid to the emergence of adults is about 3 months.

The newly emerged adult is about 9 mm long and has a soft, pale yellow elytra. The elytra later darkens in colour to become golden brown. In the laboratory, an adult survived for 23 days after its emergence although it hardly fed on the young leaves supplied.

7. *Seasonal flights*

The adult *A. rufocuprea* was observed to be abundant and active in flight from late July to September, from mid-November to early February, and from late March to May. During the other months of the year, its adult population was low or almost nil. The flights appeared to be triggered off by rains at the end of dry periods. The flight periods also coincided with the emergence of new leaves of most host plants. These new flushes provided ample food for the adult beetles.

Mating was observed to start around end March and end July. This activity lasted about 3 to 6 weeks, and was most intense on dry nights in April and August. The dissection of adult females indicated that some matured eggs had already been formed in their ovaries when mating occurred. Caging of the females which were caught mating showed that oviposition may occur a few days after mating.

Based on the observations made on the life cycle of *A. rufocuprea* and on its seasonal flights, it is deduced that the beetle has at least two generations in a year. One generation begins its egg stage in April during which mating and oviposition occur. By July, the beetle has already gone through the larval and pupal stages to

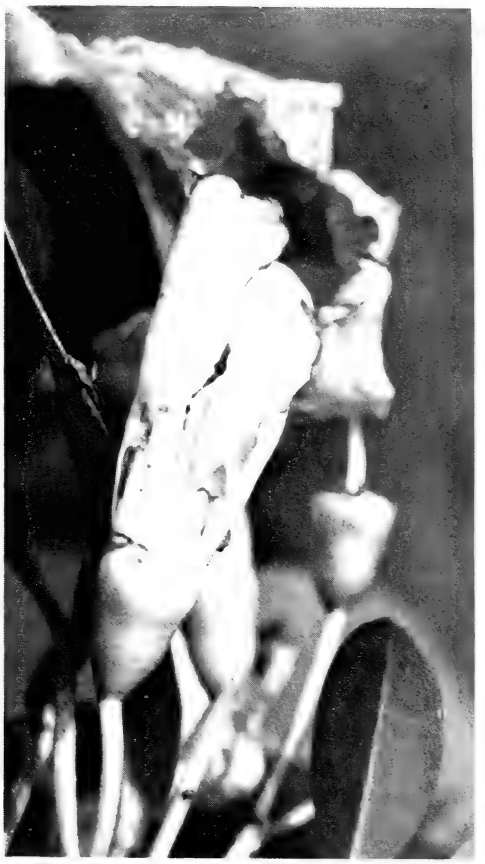


Plate 5. A flower of *Tabebuia pallida* attacked by *Autoserica rufocuprea*.

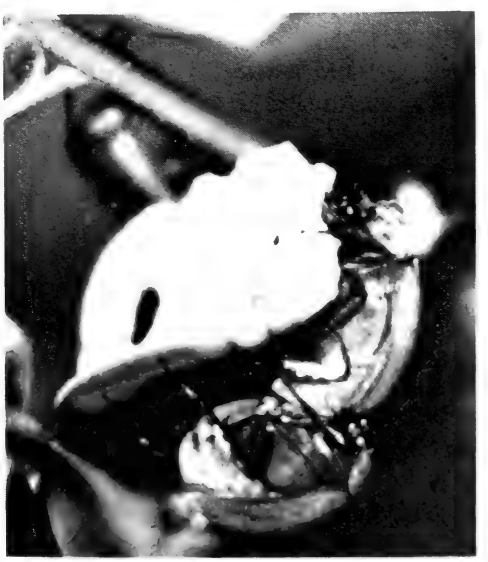


Plate 6. A pair of *Autoserica rufocuprea* mating on a leaf. Note that the female is feeding at the same time.

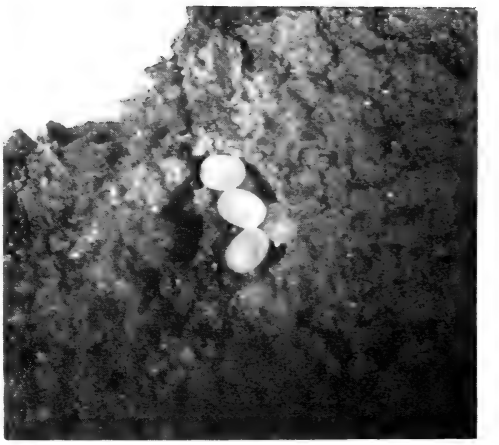


Plate 7. A batch of eggs of *Autoserica rufocuprea* inside a hollow made by the adult female in the soil.

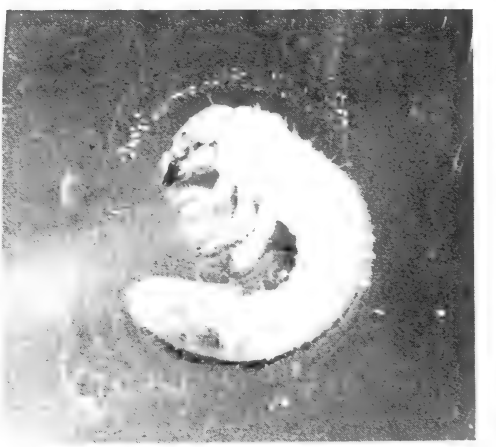


Plate 8. A full-grown grub of *Autoserica rufocuprea*, 19 mm long.

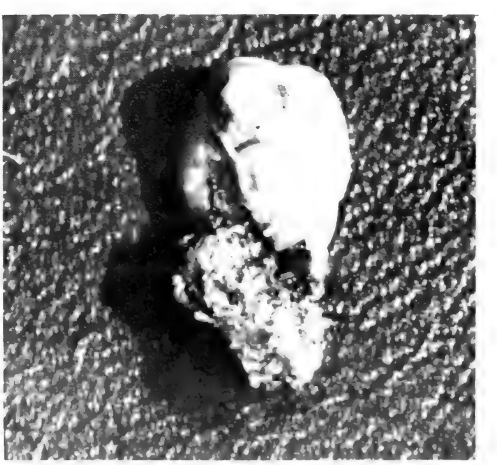


Plate 9. A pupa of *Autoserica rufocuprea*, 8 mm long.

become adults. The flight season soon occurs. Adults mate around August and oviposit. The oviposition in August marks the start of another generation. By November, the adults of this new generation are formed. The flight season then begins with the arrival of the north east monsoon rains. So far no mating of adults has been observed during the November – February flight. More intensive observations during this flight period is needed to confirm this. It will also confirm whether the beetle has three generations in a year. More studies are also needed to determine the life span of each generation of the beetle.

Conclusion

The studies confirm that *A. rufocuprea* is one of the cockchafer pests which attack many ornamental plants and shade trees at Botanic Gardens and East Coast Park in Singapore. As its food plants include the most commonly planted trees in Singapore, it is also expected to occur in most other parks, gardens and planted areas like roadside nurseries. The amount of foliar damage it incurs on young host plants during its flight periods can be fairly great. This is because of its gregarious feeding habit and the coincidence of the flight periods with the emergence of new leaves of the plants. However, the extent and severity of damage also varies with the susceptibility of host plants and its infestation level. The infestation level of the beetle is thought to be determined by a complex of ecological factors which has to be investigated further.

The studies have also revealed the beetle's flight seasons which, if consistent every year, may determine the times for spraying host plants with insecticides.

Acknowledgement

The author wishes to thank Mr D.H. Murphy of the National University of Singapore for identifying the insect under study. Thanks are also due to Miss Lein Lee Jiuan, Mr Ng Boon Teen, Miss Tan Choon Tee and students of the School of Ornamental Horticulture who helped to carry out the survey and subsequent studies. The assistance given by Mr J.F. Maxwell and the staff of the Herbarium, Singapore Botanic Gardens, in the identifications of host plants is also gratefully acknowledged.

References

Borror, D.J. & Delong, D.M. (1964). *An Introduction to the Study of Insects.* 2nd edition. Holt, Rinehart and Winston, Inc., New York. 310-317

Britton, E.B. (1979). Coleoptera. In: *The Insects of Australia.* C.S.I.R.O. Div. of Entomology. Melbourne University Press. 495-621.

Dammerman, K.W. (1929). *The Agricultural Zoology of the Malay Archipelago.* J.H. De Bussy Ltd., Amsterdam. 189-195.

Kalshoven, L.G.E. (1951). *De plagen van de cultuurgewassen in Indonesia,* part 2. W. Van. Hoeve, The Hague. 762-806.

Lever, R.J.A.W. (1953). Cockchafer pests of Cocoa and other Crops. *Mal. Agricul. Jour.* 36: 89-113.

Ritcher, P.O. (1969). *White Grubs and their Allies* . . . a study of North American Scarabaeoid larvae. Oregon State University Press. 75-89.

Southwood, T.R.E. (1966). *Ecological Methods* . . . with particular reference to the study of insect populations. Methuen & Co. Ltd., London. 233-236.

Swaine, G. (1971). *Agricultural Zoology in Fiji.* Ministry of Overseas Development, London. H.M.S.O. 424.

Yunus, A. & Ho, T.H. (1980). *List of Economic Pests, Host plants, Parasites and Predators in West Malaysia,* 1920-1978. Ministry of Agriculture, Malaysia, Kuala Lumpur. 221-228.

Diplazium prescottianum (Wall. *ex* Hook.) Bedd.: **a Singapore fern now possibly extinct**

R. E. HOLTTUM
Royal Botanic Gardens, Kew

During the months of August to November 1822, Nathaniel Wallich, Superintendent of the Botanic Garden at Calcutta, stayed in Singapore and collected many specimens of native plants. These were dried and added to his great herbarium which consisted mainly of specimens of Indian plants. He gave new names to those of his specimens which he believed to represent hithero unknown species, and a list of these names was duplicated, but as he published no descriptions his names have no status according to the present International Code of Botanical Nomenclature. Duplicates of Wallich's specimens were distributed to various other herbaria, but the Singapore herbarium had not then been founded, so any of his specimens now in Singapore are mostly stray ones which could be spared from Kew, where the main Wallich herbarium now remains.

Many of the ferns to which Wallich gave new names were first described by William Hooker in his *Species Filicum* (five volumes, 1844 – 1864) and among them was no. 235 in Wallich's list, *Asplenium prescottianum,* in Hooker's third volume (1860) p. 251. A photograph of one of two sheets of this collection in Hooker's herbarium is here reproduced. Hooker also cited a specimen collected by Thomas Lobb in Singapore about 1850 which had fewer lobed pinnae but clearly represented the same species; this was called var. β. Another specimen cited was collected by Norris in Penang and named var. γ but this has pinnae differently lobed and represents another species, now known as *Diplazium malaccense* Presl.

We now regard Wallich's species as belonging to the genus *Diplazium,* but Hooker preferred to retain it in *Asplenium* because the arrangement of the sori is almost the same in both. It was not until 1866 that Milde showed a constant anatomical difference between the two genera and also a difference in scales. Other differences are now known, and members of the two genera usually differ in habitat, species of *Diplazium* being almost all terrestrial ferns of forest, and most *Asplenium* plants are epiphytes or grow on rocks. The characters by which *Diplazium* differs from *Asplenium,* as shown by Milde, are also shared by members of the genus *Athyrium,* the name of which is older. So Copeland, in his early work on Philippine ferns, transferred all species formerly known as *Diplazium* to *Athyrium;* he continued this practice in his book Genera Filicum (1947), and in the original edition of my *Ferns of Malaya* I followed Copeland. In 1859 Thomas Moore had published the binomial *Diplazium prescottianum,* without a description, but as Wallich's name was not then valid, Moore's name is also invalid. In 1867 Beddome validated the name *Diplazium prescottianum* by reference to Hooker's description, and published the first illustration. Later, when Beddome wrote his full account of the Indian and Malayan ferns known to him (his *Handbook,* 1883) he ranked Wallich's species as a variety of *Diplazium silvaticum.* As indicated in the Appendix to the second edition of my book, I now accept the genus *Diplazium* as distinct from *Athyrium.* This history can be summarized as follows:

Asplenium prescottianum Wallich, cat. no. 235, invalid name; Hooker, Spec. Fil. 3: 251 (1860), excluding var. γ.

Diplazium prescottianum (Wall. ex Hook.) Beddome, Ferns Br. India: t. 243 (1867); Holttum, Ferns of Malaya ed. 2: 637 (1966).

Diplazium silvaticum var. *prescottianum* Bedd., Handb. Ferns Br. India: 178 (1883).

Athyrium prescottianum (Wall. ex Hook.) Holttum, Ferns of Malaya: 557 (1954).

The name *prescottianum* commemorates John Prescott, a botanist who helped Wallich in identifying his specimens of the family Cyperaceae; he died in 1837.

In 1875 H.J. Murton, Superintendent of the original Botanic Garden in Singapore, collected a specimen at Kranji, with no other details. C.G. Matthew, a fleet-surgeon visited Singapore early in the twentieth century collected another between Bukit Panjang and Woodlands. No more specimens were found until 1958 when Sinclair collected specimens at Tanjong Gul, with the following note: "rocky wooded cliffs, at base of cliff; only two plants seen". Sinclair's is the only definite information about the nature of the habitat of this fern. Murton's locality Kranji probably indicates that he found it at the steep seaward face of the hill at Woodlands, which was then still covered with forest trees, like the present cliffs at Labrador.

The very peculiar shape of the pinnae of this species is well shown in the photograph, namely the deep lobing of middle pinnae near their bases on the acroscopic side only, and the long-stalked lower pinnae which have no similar lobing. Fronds of smaller plants have fewer lobed pinnae and fewer lobes on each; the specimens of Thomas Lobb and of Sinclair both show this condition. The pinnae are of a much firmer consistency than those of most species of *Diplazium* in Malaya; this is probably to be correlated with the semi-exposed position in which the plants grow. Most species of this genus grow only in the full shade of forest. I suggest that the most likely places where other plants of *D. prescottianum* may exist are in the Indonesian islands near Singapore. My impression is that collecting there has been less thorough than in Singapore, but there may be specimens, unreported, in the herbarium at Bogor.

As indicated on p.557 of the original edition of my book on the ferns of Malaya, I tentatively included also in this species some specimens from Selangor and Perak. But later study convinced me that they represented another species, not yet named; a comment to this effect is made on p.637 of the second edition. *D. prescottianum* has been more recently reported (as *Athyrium prescottianum*) by S. C. Chin as occurring at Gua Panjang in Kelantan (Gard. Bull. 30: 210, 1975). I have now seen a photograph of a specimen from this collection (UNESCO Limestone Expedition 1962, no. 517); in my opinion it belongs to the species *Diplazium crenato-serratum* (Bl.) Moore.

The number of species of *Diplazium* in S.E. Asia and Malesia is very large, and many of them have never been adequately described, so that the application of such names as exist is often doubtful. The detailed structure of the scales which cover the apex of rootstocks and the bases of stipes provide useful and precise diagnostic characters but these

Photograph of a sheet from the type collection of *Asplenium prescottianum* Wall. in Kew Herbarium. *Courtesy of the Director, Royal Botanic Gardens, Kew.*

scales are often missing from herbarium specimens and in many species they have not been well described; this is true of the species of India where more exist than those recognized in Beddome's works. Type specimens need re-describing so that the precise meaning of existing names may be established before new names are given. Probably there are many Malesian species still undescribed; even in Peninsular Malaysia, one of the best-studied areas, there are still some.

However *D. prescottianum* is peculiar in two ways. First, it has very obvious distinctive characters, so that it is unlikely to have escaped the notice of collectors. Secondly, it does not grow in high forest, and if it exists away from the sea it must be in some more open, though not fully exposed places; it is probably adapted to peculiar habitat-conditions which are not common. So it may be now on the verge of extinction, if not already extinct. If further plants of this species are found, I hope that someone will try to grow new ones from spores, not destroy them in making more dried specimens.

Another fern which grows in somewhat similar habitats near the sea in Singapore is *Dipteris conjugata,* but this species certainly occurs abundantly elsewhere in Malesia, on mountains at altitudes of about 600 to 1800 m, in open places, and is conspicuous at all hill stations. It was formerly present in several small colonies on the steep sea-facing cliffs at Labrador, where it had strong light from the sea and little overhead shade. It also occurred in at least two places near the sea in the N.W. of Singapore, and Sinclair found plants on Pulau Serimbun in 1953. Unless specially protected and brought to public attention, it is likely to disappear from Singapore. It differs from *Diplazium prescottianum* in having a creeping rootstock which can go on growing indefinitely, whereas *Diplazium* has a more or less erect rootstock which is of limited growth and plants need to be renewed from spores periodically.

Dipteris conjugata does not renew itself from spores in Singapore. It only does this at altitudes of about 600 m or more above sea level, as anyone who walks up Penang Hill by the old path can easily see; at about 600 m altitude young plants of *Dipteris* are abundant, but below that level there are none. This must be an effect of temperature; the spores will not germinate, or the prothalli will not produce their generative organs, at the warmer temperature of sea level. I believe that *Dipteris* became established on the Labrador cliffs during the ice age when the sea level was lower than it is now, and the temperature at Labrador was like that of the top of Penang Hill today; and that the *Dipteris* persisted because it could not be fully overshaded by forest growth on that steep ground. However, this is unlikely to be the explanation of the presence of *Diplazium prescottianum* in Singapore.

A New Combination for *Barclaya kunstleri* (King) Ridley of the Nymphaeaceae

BENJAMIN C. STONE
Department of Botany, University of Malaya, Kuala Lumpur, Malaysia

Abstract

As the generic name *Hydrostemma* antedates *Barclaya,* as discussed recently by Mabberley, the species of this genus must now be known as *Hydrostemma longifolium* (Wall.) Mabb. and *H. motleyi* (Hook. f.) Mabb. A probable third species, recognized by Ridley, based on *Barclaya motleyi* var. *kunstleri* King, requires a name under *Hydrostemma,* here provided as *Hydrostemma kunstleri* (King) Stone, comb. nov.

Introduction

Nathaniel Wallich, author of the generic name *Barclaya* which has been used for a century and a half for a small group of waterlilies native to Borneo, Malaya, Thailand and Burma, actually first proposed the name *Hydrostemma* for the genus. As recently exposed by D. Mabberley (1982) this name was published in June 1827, about six months earlier than *Barclaya* which was published in December 1827. This seems to be a clear case of an author changing his mind, which was acceptable in that period when no formal nomenclatural rules were universally agreed upon, but now is inadmissible according to the present International Code of Botanical Nomenclature. Although used by Hooker *filius,* G. King, Ridley and many other botanists, the name *Barclaya* is clearly a later name and must yield to *Hydrostemma.* As the genus is a small one, without the need for numerous new nomenclatural combinations, and is not significant in applied botany, Mabberley proceeded to make two needed combinations, *Hydrostemma longifolium* (Wall.) Mabb. and *H. motleyi* (Hook. f.) Mabb.

There is however another taxon, originally described by G. King as *Barclaya mottleyi* (*sic!*) var. *kunstleri* King, in honour of H. Kunstler who was in the employ of King as a plant collector in Perak (and frequently identified solely as "King's collector"). King's description (King, 1889) brings out some of the salient features of this plant, and Ridley later raised it to the rank of species (Ridley, 1922, p. 117), remarking: "This, in its thin glabrous leaves and globose seeds, is much nearer *B. longifolia* than *B. motleyi,* but the sepals are those of *B. motleyi,* as indeed is the whole flower. In the Setul plant some of the leaves are lanceolate cordate." Ridley cites a specimen from Bera, Perak (collected by Kunstler and evidently the type), and another from Setul, Bukit Rajah Wang, collected by Haniff. In ranking this plant as a species Ridley clearly placed emphasis on the leaf shape and the seed characters.

King's original description reads: "Leaves ovate-rotund, cordate, the under surfaces and petioles pubescent or glabrous, as are the peduncles; petals claret-coloured; seeds rugose, occasionally echinate. – In similar situations with the last. Perak; King's collector, Scortechini, Wray. The leaves of this are thinner in texture than those of the typical form."

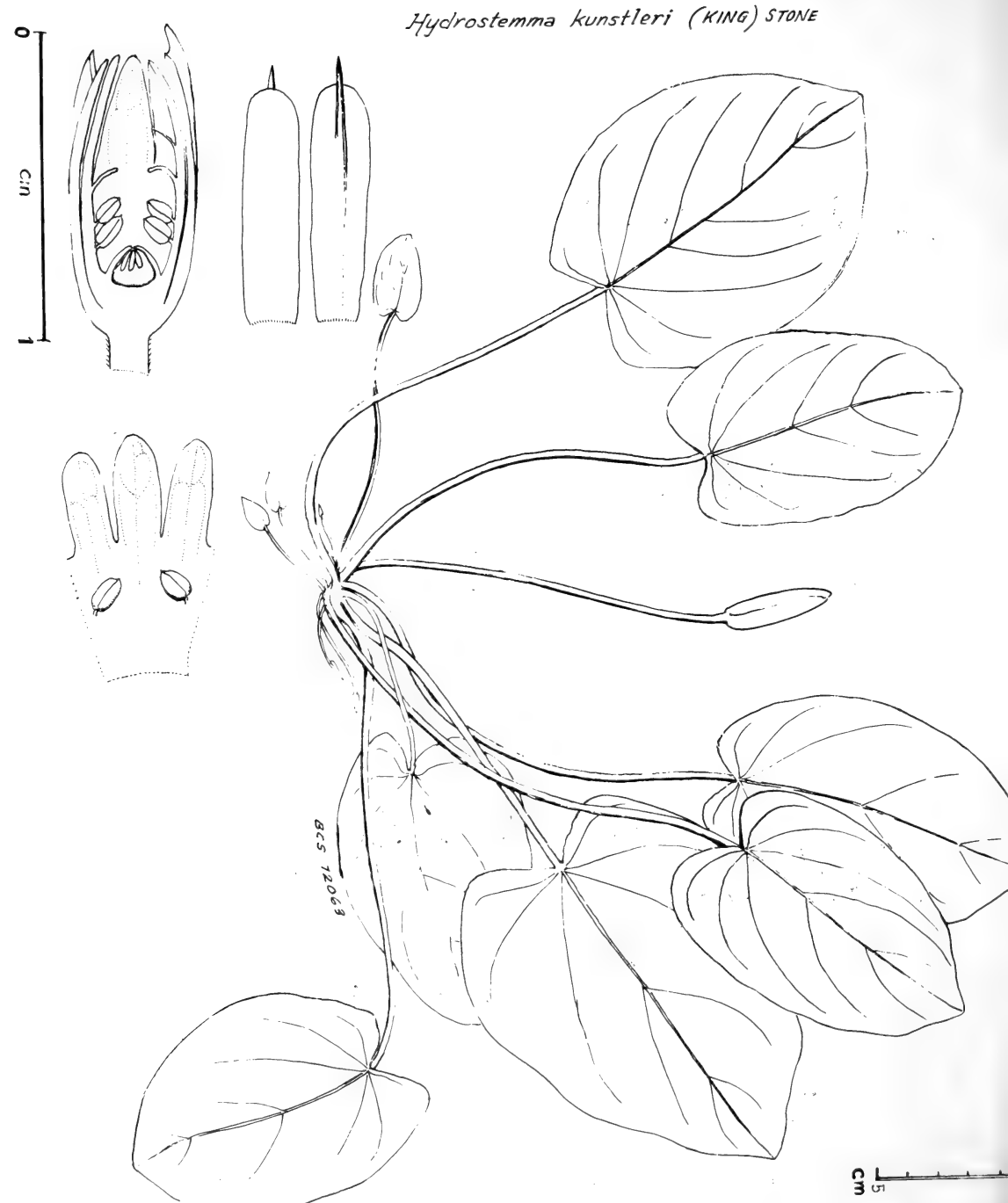


Fig. 1. *Hydrostemma kunstleri* (King) Stone. (Formerly *Barclaya kunstleri* (King) Ridley). Habit. Inset (upper left) shows flower in longitudinal section, two views, ad- and abaxial, of tepal, and (below) segment of interior of perianth showing two stamens. All from *BCS. 12063.*

From these points it appears that var. *kunstleri* does indeed merit recognition. The characters mentioned are suggestive but perhaps only the seed characters might be crucial.

Recently, this plant was collected in Selangor, Templer Park, by Stone and van Balgooy, and a note was published on it in the *Malayan Naturalist* (Stone, 1978), along with specimen citations of the other species. Flowers were present in the collection, but not seeds. The leaf shape and texture were certainly correct for the taxon *kunstleri.* Thus, though the actual status of the plant is somewhat dubious, it may be something other than a simple variety of *B. motleyi.* The possibility exists that hybridization between *B. motleyi* and *B. longifolia* occurs, or has occurred, and that *kunstleri* may be a result. Alternatively, Ridley may be right in ranking it as a species. Clearly a more detailed investigation is desirable. In the meantime, some designation is required, and it seems preferable to follow Ridley, but to use the original generic name. Thus the following new combination is made:

Hydrostemma kunstleri (King) B. C. Stone, **comb. nov.**
Syn. *Barclaya kunstleri* (King) Ridley, *Fl. Mal. Pen.* 1: 117. 1922.
B. mottleyi var. *kunstleri* King, *J. Asiat. Soc. Bengal* 58: 390. 1889.
Lectotype: Perak, *H. Kunstler* (King's collector).

Distribution. Perak: Belanja, 100 ft. alt., *L. Wray Jr. 143* (SING!). Without locality, *Scortechini* (CAL, K). Selangor: Balai Berjuntai, May 1895, *Ridley 7348* (SING!). Templer Park, *Stone & van Balgooy 12063* (KLU!). Johore: Sungei Serai, Kota Tinggi, *Teruya 370* (SING!). 5th mile Gelang Patah road, *Sinclair 10859* (SING!). Johore, without locality, *Teruya 2480* (SING!). Singapore: Nee Soon, Selitar, *Sinclair 40337* (SING! – very glabrous, resembling *B. motleyi*).

This plant is very infrequently collected and certainly deserves further study to clarify its status.

References

King, Sir George. 1889. Materials for a flora of the Malayan Peninsula. Orders I – VIII. *Journal of the Asiatic Society of Bengal* 58: 359-408. (Cfr. pp. 389-391, Order VI).

Mabberley, D. J. 1982. William Roxburgh's "Botanical Description of a new Species of *Swietenia* (Mahogany)" and other overlooked binomials. *Taxon* 31: 65-73.

Ridley, H. N. 1922. *Flora of the Malay Peninsula.* Vol. I. Polypetalae. 1-918. London: L. Reeve & Co. (Cfr. pp. 116-118).

Stone, B. C. 1978. *Barclaya,* the Malaysian "Waterlily". *Malayan Naturalist* (for Sept. 1978): 20-22. With 1 figure.

Micropropagation of *Saintpaulia* at Singapore Botanic Gardens

LIM-HO CHEE LEN AND LEE SWEE MENG
Botanic Gardens, Singapore

Abstract

Experimental propagation of *Saintpaulia* by means of leaf and petiole culture was conducted at the Singapore Botanic Gardens. All in, 17 varieties were used. Leaf culture of 15 varieties and petiole culture of 3 were successful. Shoots were found to initiate readily in a large variety of media but satisfactory rooting occurred only in media with a low level of growth regulators such as IAA. After the plantlets were transferred into soil, it was found necessary to keep them in an enclosed environment for about two months in order to ensure a high survival rate.

Introduction

Saintpaulia is commonly propagated vegetatively from leaf cuttings by amateurs and commercial growers. Although new plants can be grown from leaf cuttings within 6–8 weeks, the number of plants per crop that can be obtained by this method is small. This method is therefore not satisfactory for commercial mass production.

Tissue culture of *Saintpaulia* has been successfully attempted in western countries (Kukulozanka and Suczynaka 1972, Start & Cumming 1976, Bilkey et. al. 1978). Their reports gave fairly detailed accounts of the initiation of shoots and roots in culture. However, very little information is available on the technique of transplanting plantlets from flasks into the open.

The Singapore Botanic Gardens started experiments on tissue culture of saintpaulias about 4 years ago. So far 15 varieties have been successfully propagated by this technique and seven of them are now being mass-propagated at the laboratory. Our experiments and technique are described in this report.

Micropropagation of *Saintpaulia*

(a) *Method*

Fully expanded young leaves with a petiole 3–4 cm long were used. The leaves were washed in soap water, then soaked in detergent for 15 minutes to remove dirt, thereafter sterilized by soaking in 10% clorox solution for 10–20 minutes, and finally rinsed several times with sterilized distilled water.

After disinfection, the leaves and petioles were cut apart and then each sliced into 3 portions. The leaves were sliced such that each segment carried a section of the midrib.

Murashige and Skoog's formula (1962) was used with the addition of the following growth regulators:

(1) 2.5 mg/l kinetin, 5 mg/l IAA (AS)
(2) 0.3 mg/l NAA, 0.1 mg/l kinetin, 40 mg/l adenine sulphate (ASP)
(3) 0.1 mg/l NAA, 0.01 mg/l BA (AF)
(4) 0.2 mg/l BA, 0.1 mg/l zeatin (WSK6)
(5) 2 mg/l BA, 1 mg/l zeatin (WSK3)
(6) 2 mg/l IAA, 2 mg/l kinetin (AB)

The explants were cultured on 20–30 ml of the medium in conical flasks or on 10–20 ml of medium in test tubes. Each leaf segment was placed upright in the culture with one quarter of its length embedded in the agar. The cultures were exposed to Gro-lux lighting for 10 hours a day and maintained at an environmental temperature of 20–25°C. Two tubes, each of 30 watts were positioned a foot above the bench.

(b) *Results of leaf culture*

A total of 15 different varieties of *Saintpaulia* had successfully proliferated through leaf culture (Table 1). After about 3 weeks, tissues of leaf explants began to enlarge and thicken. Shoots first appeared at the base of the midribs, touching the medium and rapidly spreading to the entire adaxial area of the blade. Although all explants were placed upright in the medium, only a few shoots formed on the abaxial surface of the lamina and these were mainly located around the midrib. After 1–2 months the whole flask was crowded with shoots, initiated from the leaf explants and the culture was then ready for transfer.

(c) *Results of petiole culture*

In petiole culture, swelling of the petiole was often observed around the circumference. In most cases, the central portion at the cross-sections showed no growth and gradually browned off. After 1–2 weeks, callus growth began. Most of the petiole cultures formed callus alone or with roots. About 20% of the cultures formed shoots (Table 1). Plantlet regeneration became noticeable after 6 weeks.

The cultures of petioles were much less successful than those of leaves. So far only 3 varieties differentiated plantlets from cross-sections of excised petioles in vitro.

Shoot multiplication and root formation

After about 2 months, the shoots had to be transferred (Plate 1). Shoots taller than 1 cm were separated with forceps and placed on a rooting medium which consisted of Murashige and Skoog's medium plus 0.1 mg/l IAA. Those shorter than 1 cm were subcultured for multiplication. The medium for multiplication was also Murashige and Skoog's but with 0.5 mg/l kinetin and IAA.

On the multiplication medium, these plants developed into a compact spherical mass of multiple shoots in 6 weeks. Where the shoots had not been subcultured after 3 months, some became dominant, suppressing the growth of the others.

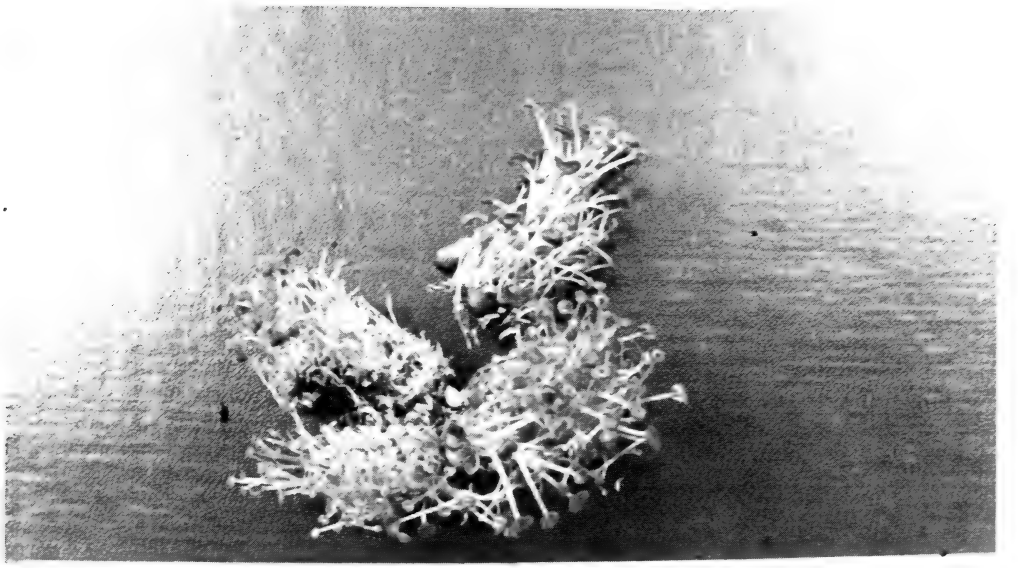


Plate 1. Leaf-cultured *Saintpaulia*, P1, with multiple shoots.

Plate 2. Leaf-cultured *Saintpaulia*, P1, ready for transplanting.

Table 1

***Saintpaulia* varieties successfully propagated by tissue culture technique**

Departmental Code	Description	Proliferation media	Explant	Proliferation time	Formation of plantlet
	WHITE VARIETIES				
W1	White (R.H.S. 155D), double petals, light purplish centre; entire or serrated leaves.	AS AB	leaf	2 weeks	+++
W2	White (R.H.S. 155B), double petals, leaves with slightly indented margins.	ASP	leaf petiole	3 weeks 5 weeks	+++ ++
W3	White (R.H.S. 155D), double petals, trailer; entire, pointed leaves.	AS	leaf	6 weeks	+
	PINK VARIETY				
P1	Rhodamine Pink (R.H.S. 62A, H.C.C. 527), double petals; entire or serrated leaves.	AS AB	leaf petiole	4 weeks 5 weeks	+++ ++
	BLUE AND VIOLET VARIETIES				
B/P1	Gertian blue (R.H.S. 96B), double petals; entire, rounded leaves.	AB	leaf	3 weeks	+++
B/P2	Violet-blue (R.H.S. 89A), single petals; entire or serrated leaves.	AC	petiole leaf	6 weeks 6 weeks	++ ++
B/P3	Violet-blue (R.H.S. 89B), single petals; velvety texture; entire leaves.	AB	leaf	5 weeks	++
B/P4	Violet-purple (R.H.S. 77A, H.C.C. 733) double petals; entire leaves.	AB	leaf	4 weeks	+++
B/P5	Violet-purple (R.H.S. 77A, H.C.C. 733), single star-shaped petals; entire or serrated leaves.	AS	leaf	4 weeks	++
	VARIEGATED FOLIAGE				
VF1	Pink (R.H.S. 73B), double petals; Tommie Lou's foliage.	AS	leaf	3 weeks	++
VF2	Roseine Purple (R.H.S. 68C, H.C.C. 629/2), single petals; Tommie Lou's foliage.	ASP	leaf	3 weeks	+

Table 1 *(cont.)*

***Saintpaulia* varieties successfully propagated by tissue culture technique**

Departmental Code	Description	Proliferation media	Explant	Proliferation time	Formation of plantlet
	TWO-TONE AND MULTICOLOUR				
TC1	Solferino Purple (R.H.S. 65B, H.C.C. 26/3) with Spiraea Red (R.H.S. 63C, H.C.C. 025/2) radiating from the centre and bordering the edge, single fringed petals; big and heavily rippled leaves, almost bordering on fringe.	AF	leaf	5 weeks	+
TC2	Pink (R.H.S. 62D) double petals, with good white edge; entire, pointed leaves.	AC	leaf	2 weeks	+
TC3	Violet-blue (R.H.S. 93B) with narrow white edge; semi-double petals; entire or serrated leaves.	AF WSK6	leaf	4 weeks	++
TC4	Aster purple (R.H.S. 87C, H.C.C. 38/2) with irregular dashes of white, single to semi-double petals; entire leaves.	ASP WSK3	leaf	6 weeks	++

R.H.S.: Royal Horticultural Society Colour Chart, London, 1966
H.C.C.: Horticultural Colour Chart, The Royal Horticultural Society, 1941

+: 1–5, shoots
++: 6–15, shoots
+++: 15 and above shoots.

Table 2

The survival rate of *Saintpaulia* in open frames compared with covered ones

Code of variety	Colour	Open frame			Enclosed frame		
		Number planted	Size of frame	Survival rate	Number planted	Size of frame	Survival rate
B/P1	Gertian Blue	30	23 x 30 x 15 cm	10%	36	23 x 30 x 15 cm	100%
B/P4	Violet-purple	40	46 x 31.5 x 52 cm	10%	33	46 x 31.5 x 52 cm	100%
P1	Rhodamine Pink	30	23 x 30 x 15 cm	20%	117	127 x 70 x 60 cm	100%

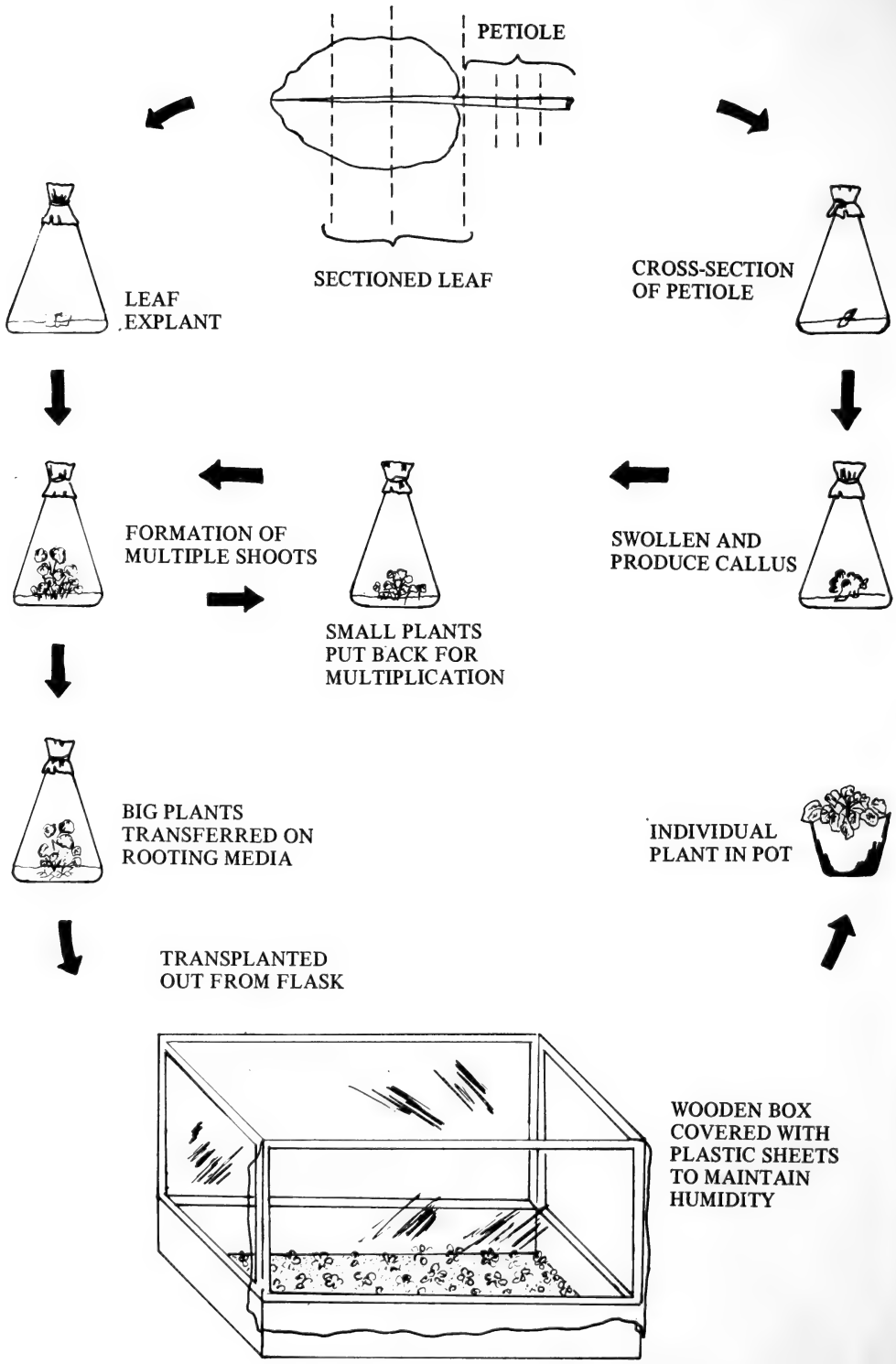


Fig. 1. Propagation Of Saintpaulia By Tissue-Culture Technique Pictorially Represented

Transplanting

Plantlets 2.5 cm in diameter with 6–8 leaves (Plate 2) were removed from the flask with long forceps. They were rinsed 2–3 times with distilled water to remove the attached agar and then soaked in a 0.5% Tersan 75 solution for about 5 minutes. The plantlets were transferred into sand-frames which were covered with a plastic sheet. They were incubated for 2 months and watered once a fortnight. So far all those transplanted into sand-frames which were covered have survived. In contrast, when open frames were used, at the earlier stages of our experiment, only 10–20% of transplanted plantlets have survived (Table 2). The size of the frames, however, did not appear to have a significant effect on the survival rate. After 2 months in the covered sand-frames (Plate 3) the plantlets were ready for transfer into individual pots.

Potting Stage

The mature plants from the sand-frames were potted individually in soil mixtures at the nursery. They grew well in a large variety of soil mixtures. A good mixture is obtained by mixing equal portions of topsoil, sand and peat. The plants were watered on alternate days and fertilised once a week with a concentration of NPK 75:60:60-p.p.m. Spraying with a mixture of 0.05% Rogor and of 0.15% of Captan 50 was carried out fortnightly.

Summary and Discussion

Our experiments showed that for *Saintpaulia,* leaf culture is preferable to petiole culture. The procedures are summarised in figure 1.

The cultures appeared to develop well on a variety of media. However, an overdose of growth regulators in the rooting medium tended to stimulate development of axillary shoots at the expense of root-development.

A crucial stage of propagation is the planting out of plantlets from flask. It appeared that most of them need to be incubated for about 1–2 months in an enclosed environment to enhance survival. The reason seems to be that the roots of the tissue-cultured plantlet cannot initially take on all their functions when planted in soil. Failure to replace water which was depleted rapidly through the leaves led to wilting and death. It is therefore necessary to keep the newly released tissue-cultured plantlets under heavy shade and in an enclosed environment until roots function fully. Fossard (1972) using scanning electron microscopy revealed that plants growing in culture have little or no crystalline wax on their leaves. This lack or low quality of crystalline wax on leaves increases transpiration and water-loss. The same may be the cause of rapid dessication of tissue-cultured plantlets when these are removed from their humid environment in the culture flask and placed in a drier condition.

Compared with the conventional leaf-cutting method, tissue-culture propagation has the following advantages:

(1) very little space is required
(2) growth rate is greater
(3) new cultivars can be readily propagated

Plate 3. A sand-frame planted with *Saintpaulia,* P1, B/P2, B/P4 & B/P5, two months old. (Uncovered here to show details).

Plate 4. *Saintpaulia,* B/P4, from tissue-culture, grown in shade at the potting yard, with a compact rosette of leaves.

Plate 5. *Saintpaulia*, B/P4, propagated from leaf-cutting grown in shade at the potting yard with a loose rosette of leaves.

An interesting unexplained difference between plants derived from tissue culture and conventionally propagated ones has been observed. The tissue-cultured plants in general have a compact rosette of leaves with a short petiole (Plate 4) and the flower stalk is also short. Conventionally grown plants often have a loose rosette of leaves with a long petiole, and a long flower stalk (Plate 5). Tissue-cultured plants therefore are further enhanced for marketing purposes.

References

Balkey, P.C. and A.C. Hildebrandt 1978. Micropropagation of African Violet from petiole cross-sections. *Hort. Science* 13: 37-38.

De Fossard, R.A. 1980. Tissue Culture Propagation. *University of Hawaii Harnold L. Lyon Arboretum Lecture Number Ten*: 1-40.

Kukulczanka, K. and C. Suczynaka 1972. Regenerative properties of *Saintpaulia ionanthe* Wendl. leaves cultured in vitro. *Act. Soc. Bot. Pol.* XLI: 503-505.

Murashige, T. and F. Skoog 1962. A revised medium for rapid growth and bioassays with tobacco culture. *Plant Physiol.* 15: 473-497.

Start, N.D. and B.G. Cumming 1976. In vitro propagation of *Saintpaulia ionantha* Wendl. *Hort. Science* 11: 204-206.

Annotated List of Seed Plants of Singapore (VII)*

HSUAN KENG
Department of Biology, National University of Singapore

Index to Families

II. Angiospermae-Dicotyledons (cont'd)

94. Aquifoliaceae

Ilex cymosa Bl.

Small tree; flowers small, greenish, in branched axillary cymes; fruit small, ovoid, purple then black, with 8-10 stones inside. In mangrove and swamp forests, Chua Chu Kang (*Goodenough 1862*).

Ilex macrophylla Hk. f.

Leaves thin and papery; fruit red. In forest. Bukit Timah (*Sinclair 40199*).

Ilex maingayi Hk. f.

Leaves leathery with a stout petiole; fruit red. Bukit Mandai (*Mat 6742*).

95. Celastraceae

Key to the genera

A. Stamens 4 or 5; erect shrubs or trees

B. Leaves alternate or spiral — *Bhesa*

B. Leaves opposite

---

*continued from *Gdns' Bull. Sing.* 32: 329. 1980.

C. Fruit fleshy, indehiscent — *Cassine*

C. Fruit splitting by valves

D, Ovules 2 in each locule — *Euonymus*

D. Ovules 4 to many in each locule — *Lophopetalum, Kokoona*

A. Stamens 3, rarely 2; climbers, rarely erect shrubs or small trees

E. Flowers mostly in axillary clusters; fruit pulpy, indehiscent — *Salacia*

E. Flowers in axillary cymes or terminal panicles; fruit splitting into follicle-like parts — *Reisantia, Loesenerilella*

Bhesa paniculata Arn. (= *Kurrimia paniculata* Wall. ex Arn.)

Tree; twigs reddish brown, rounded, with horizontal stipular scars; leaves elliptic, 6-40 cm long, shiny below; flowers greenish, in panicles; fruit 2-lobed, 2-seeded, yellow to red; seeds with pink aril. In lowland forests, fairly common, Water Catchment Area, Bukit Timah, Bukit Mandai (*Goodenough 4940*).

Bhesa robusta (Roxb.) D. Hou (= *Kurrimia robusta* Roxb.)

Tree; twigs flattened and angled, grey; stipular scars usually oblique; leaves elliptic, 6-16 cm long; flowers red, in spikes; fruit 1-seeded. In lowland forests, less common, Tanglin, Bukit Mandai, P. Damas Laut (*Sinclair 39244*).

Cassine viburnifolia (Juss.) D. Hou (= *Elaeodendron subrotundum* King)

Shrub or small tree; leaves opposite, decussate, margin wavy; flowers in cymose panicles; fruit obovoid, indehiscent. On sandy beaches, Kranji, Katong, P. Brani (*Ridley 8072*).

Euonymus javanicus Bl.

Large shrub; leaves opposite, decussate, elliptic, 5-20 cm long; flowers solitary or in small clusters; fruit angled or lobed; seeds black, with orange aril. In swamp forests, Kranji, Sembawang (*Mat 6529*).

Kokoona littoralis Laws. (= *Lophopetalum littoralis* Ridl.)

Tree; leaves elliptic, 4-15 cm long; flowers in racemes; fruit a 3-angled capsule; seed terminally winged. Collected by Thomas Lobb, probably extinct now.

Lophopetalum wightianum Arn. (= *L. fimbriatum* Wight)

Tree; leaves oblong-elliptic to elliptic, 8-25 cm long; flowers yellow, in panicles to 12 cm long; capsule 10-15 cm long. Changi, Bukit Mandai (*Mat 6776*).

Reissantia indica (Willd.) Halle (= *Hippocratea indica* Willd.)

Climber; leaves oblong elliptic or ovate, 3.5-13 cm long; flowers small, yellowish, in cymose clusters; fruit of 3 separate 'follicles', 3-5.5 cm long. In sea-shore forests, Changi (*Ridley 1918*), Pulau Ubin.

Salacia chinensis L. (= *S. latifolia* Wall. ex Laws.)

Climber, scandent shrub or rarely a small tree; leaves oblong obovate to suborbicular, 4-17 cm long; flowers yellowish, in axillary clusters; fruit globose, orange-red, 1.5-2 cm across. In seashore forests, Loyang (*Holttum s.n.*, Apr. 1949).

Sal. exsculpta Korth. (= *S. rubra* Laws.)

Climber; leaves oblong elliptic, 5-9 cm long; flowers yellow; fruit broadly obovoid, 3 cm across. In inland forests, Gardens' Jungle (*Ridley 5660*).

Sal. grandiflora Kurz

Liana or scandent shrub; leaves oblong elliptic, 7-34 cm long; flowers whitish or yellow; fruit pinkish, 2.5-5 cm across. In inland forests, Bukit Timah (*Mat 6775*), Chua Chu Kang.

Sal. korthalsiana Miq.

Climbing or erect shrub; leaves oblong-ovate or elliptic, 6-26 cm long; fruit subglobose, 2-3 cm across. In belukar, Reservoir Jungle (*Corner s.n.*, Dec. 1935).

Sal. macrophylla Bl. (= *S. flavescens* Kurz)

Liana, sometimes shrubby; leaves lanceolate to ovate, 7-34 cm long; flowers yellow in axillary fascicles; fruit broadly ellipsoid, orange or red. In forests. Pierce Reservoir (*Md Shah and Sidek 4090*), Changi.

Sal. viminea Wall. ex Laws.

Scandent or rarely erect shrub; leaves elliptic, 5-14 cm long; fruit globose, about 2 cm across. In lowland forests, Bukit Timah (*Ridley 5850*), Gardens' Jungle.

96. Rhamnaceae

Key to the genera

A.	Erect small trees or shrub; ovary half-inferior or superior	
B.	Spiny; ovary superior; fruit drupaceous	*Ziziphus*
B.	Unarmed; ovary half-inferior; fruit capsular	*Colubrina*
A.	Woody climbers; ovary half-inferior	
C.	Fruit with a narrow apical wing, indehiscent	*Ventilago*
C.	Fruit oblong, flat, not distinctly winged, dehiscent	*Smythea*

Colubrina asiatica Rich. ex Bongn.

Shrub; leaves ovate, 3-7 cm long, 3-nerved from base; flowers small, greenish in axillary cymes. Common along sea coast, Geylang (*Ridley 8123*), Changi.

Smythea lanceata (Tul.) Summerh. (= *S. pacifica* Seem.)

Climber; leaves lanceolate to elliptic, 5-9 cm long, 3-5 nerved from base; flowers green. In belukar near the sea, Serangoon River (*Ridley 9151*), Tuas.

Ventilago malaccensis Ridl.

Woody climber, slender, branched; leaves narrowly ovate, 6-12 cm long; flowers green; fruit small, round, with a long, narrow wing. In the forest, Gardens' Jungle, Bukit Timah (*Ridley 6376*), Pulau Ubin.

Ziziphus calophylla Wall. ex Hk. f.

Thorny climber; leaves coriaceous, 3-nerved, elliptic oblong, 7-12 cm long, with sharp stipular prickles; flowers white; fruit globose, orange, edible. In belukar, Gardens' Jungle, Bukit Timah, Seletar (*Ridley 3646*).

Ziz. jujuba Mill.

Small thorny tree with spreading, drooping branches; leaves elliptic, 2.5-6.5 cm long, finely toothed; flowers greenish white, in clusters; fruit ovoid or round, 2-3 cm across. Native to India and China, occasionally planted for the edible fruits. Dried fruits and those preserved in syrup are sold in shops. Vern. *Indian jujube, Chinese date.* 棗樹

Ziz. oenoplia Mill.

Thorny bush; leaves lanceolate to ovate, 2-3 cm long, unequal-sided, rusty-pubescent beneath; flowers yellowish green; fruit round, black. In open belukar, (*Hullet 242*), or as hedges.

97. Vitaceae

Key to the genera

A. Erect shrubs or small trees; ovule one in each ovary locule — *Leea*

A. Climbers with tendrils; ovules 2 in each locule

B. Flowers borne on or sunk in flattened leaf-like rachis — *Pterisanthes*

B. Flowers in spicate or cymose inflorescences — *Vitis*[1]

---

1 The view that the genus *Vitis* should be divided into a number of smaller and better defined genera has latterly gained a wider acceptance (Backer & Bakhuizen, Latiff and others). The re-combined binomials are given in brackets as alternative names. A key to these genera which are represented in Singapore is as follows:

1. Petals 5, connate at the top to form a cap which falls as the flower-bud expands (leaves simple; seeds beaked at the base) — *Vitis (s. str.)*

1. Petals 4 or 5, free

2. Inflorescence with tendrils; flowers 4- to 5-merous (seeds dorsally compressed) — *Ampelocissus*

2. Inflorescence without tendrils; flowers mostly 4-merous

3. Flowers unisexual; carpellate flowers often with a broadened, lobed stigma — *Tetrastigma*

3. Flowers bisexual, the stigma neither broadened nor lobed

4. Leaves variously divided into 3-12 parts or leaflets; berry 2- to 4-seeded — *Cayratia*

4. Leaves simple; berry 1-seeded — *Cissus*

Leea angulata Korth ex. Miq.

A thorny tree; leaves much narrower than those of *L. indica;* flowers white. Pasir Panjang (*Ridley 10401*).

Leea indica (Burm. f.) Merr. (= *L. sambucina* Willd.)

Large shrub, 3-4 m tall; leaves 2-3 times pinnate, 45-60 cm long; leaflets 7-9 in a pinna; flowers greenish white, in a large flattened complicated cyme to 35 cm wide; berry dark red to black. Common, Tanglin, Bukit Timah, Water Catchment Area.

Leea rubra Bl. ex Spreng.

Shrub, 2-3 m tall; flowers dark red. Tanglin, King's Road (*Ridley s.n.* in 1893).

Pterisanthes pilita (Miq.) Laws. (= *P. coriacea* Korth.)

Slender climber; leaves simple, ovate; inflorescence-axis ribbon-like, red, long-stalked; berry small, black, on rachis. In thick forests, Bukit Mandai, Bukit Timah, Chua Chu Kang (*Ridley 6013*).

Vitis cinnamomea Wall. (alt. name: **Ampelocissus cinnamomea** (Wall.) Planch.)

Climber, stem slender, woolly; leaves ovate-cordate or 3-lobed, 10-12 cm long, cinnamon-tomentose beneath. Chua Chu Kang, Bukit Timah, Water Catchment Area.

Vitis diffusa Miq. (alt. name: **Cissus diffusa** (Miq.) Amsh.)

Climber stem glabrous, slender, woody, foetid; leaves simple, ovate, 6-7 cm long; berry glabrous, black. In waste ground.

Vitis elegans Kurz (alt. name: **Amp. elegans** (Kurz) Gapnep.)

Climber, densely red-tomentose; leaves 3 to 5-foliate, the central one 12-15 cm long. In hedges and borders of forests, common; Gardens' Jungle, Water Catchment Area (*Pannell & Samsuri 1008*), Jurong.

Vitis furcata Laws.

Climber, stem flat, 4-angled, brown, corked along the edge; leaves simple, fleshy, 5-10 cm long; berry black. Bukit Timah, Bukit Mandai, Tanglin.

Vitis hastata Miq. (alt. name: **Ciss. hastata** (Miq.) Planch.)

Herbaceous climber; stem 4-angled, narrowly winged; tendrils reddish; leaves simple; 6-8 cm long, the base broadly arrow-shaped; berry ellipsoid, black. Common in open places, climbing over bushes, (*Hullett 3*).

Vitis glaberrima Wall. (alt. name: **Ciss. glaberrima** (Wall.) Planch.)

Tall glabrous vine; leaves simple, elliptic, 3-8 cm long; flowers in compound umbels; fruit small, rounded, pink to black. Bukit Timah, Bukit Mandai, Mandai Road (*Sinclair 39695*), Changi.

Vitis gracilis Wall. (alt. name: **Amp. gracilis** (Wall.) Planch.)

Climber, stem very slender, red hairy; leaves simple, cordate, 7-9 cm long. Changi, Tanglin, Water Catchment Area (*Ridley 268*).

Vitis lawsoni King (alt. name: **Tetrastigma lawsoni** (King) Burkill)

Tall climber; leaves 3-foliate, mid-leaflet oblanceolate, 9-13 cm long, fruit large; globose (over 2 cm across), yellowish, edible. In forests, Bukit Timah, Gardens' Jungle.

Vitis macrostachya Miq. (alt. name: **Amp. spicifera** Planch.)

Climber, glabrous; leaves simple, ovate, 9-15 cm long; inflorescence spicate, 40-60 cm long; often branched. Tanglin, Bukit Timah, Jurong (*Ridley 5585*).

Vitis mollissima Wall. (alt. name: **Cayratia mollissima** (Wall.) Gapnep.)

Climber, stem with long stiff hairs; leaves with 3 leaflets, the mid-leaflet elliptic, 8-10 cm long; berry large, globose (1.5-2 cm across), pink. Gardens' Jungle, Water Catchment Area.

Vitis novemfolia Wall. (alt. name: **Cayr. novemfolia** (Wall.) Burkill)

Slender, glabrous vine; leaves palmately compound, with 7-9 leaflets, the leaflets lanceolate, 10-12 cm long; berry globose, 2 cm across, green, Tanglin, Chua Chu Kang (*Ridley 10689*).

Vitis repens W & A.

Glabrous, herbaceous climber; leaves simple, cordate, 6-9 cm long; berry small, globose or pear-shaped, red to black. Fort Canning, Chua Chu Kang.

Vitis trifolia L. (alt. name: **Cayr. trifolia** (L.) Domin)

Slender herbaceous vine, glabrous; leaves 3-foliate, the mid-leaflets ovate-elliptic, 3-6 cm long; berry small, globose. Common, Water Catchment Area, Geylang (*Teruya 2470*).

Vitis vinifera L.

The grape vine is native to W. Asia and the Mediterranean. Occasionally planted. The fruits in markets are all imported. 葡萄

98. Sapindaceae

Key to the genera

A. Leaves 3-foliolate

B. Erect shrub; fruit a drupe — *Allophyllus*

B. Herbaceous climber; fruit an inflated capsule — *Cardiospermum*

A. Leaves pinnately compound

C. Leaves odd-pinnate; fruit woody, spiny; seed without aril — *Paranephelium*

C. Leaves even-pinnate

D. Fruit succulent

E. Seeds arillate

F. Sepals large, imbricate, free — *Xerospermum*

F. Sepals small, valvate, connate at base — *Pometia, Nephelium, Euphoria, Litchi*

E. Seeds not arillate — *Lepisanthes*

D. Fruit dry, dehiscent

G. Fruit inflated, bladder-like with 3 wings — *Arfeuillea*

G. Not as above

H. Fruit 2-lobed — *Arytera*

H. Fruit mostly 3-lobed or 3-angled

I. Fruit 3-lobed, 3-4 cm long — *Trigonachra*

I. Fruit 3-angled or winged, less than 2 cm long

J. Leaflets whitish beneath; inflorescence not or rarely branched; fruit 3-winged — *Guioa*

J. Leaflets not whitish beneath; inflorescence branched; fruit 3-angled — *Mischocarpus*

Allophyllus cobbe (L.) Raeusch.

Shrub very variable; leaves 3-foliolate, the leaflets elliptic, 4-9 cm long; flowers white, in racemes; berry red. Common along seashores, Kranji, Seletar, Jurong.

Arfeuillea arborescens Pierre

Small tree; leaflets 3-4 pairs, elliptic, 3-8 cm long; flowers greenish white, in hairy panicles; fruit inflated, bladder-like, 3-4 cm long, 3-winged. Native of Thailand, planted as a roadside tree in Singapore.

Arytera littoralis Bl.

Shrub or small tree; leaflets 2-6 pairs, lanceolate, 8-15 cm long; flowers small, in axillary panicles; fruit 2-lobed; seeds black, with red aril. Formerly collected from Chua Chu Kang by Cantley's Collector, now probably extinct.

Cardiospermum halicacabum L.

Slender vine; leaves 3-foliolate, the leaflets ovate, 1-4 cm long; flowers unisexual, irregular, in branched racemes which have terminal tendrils; capsule inflated ('balloon vine'). Occurs in waste ground, sometimes used as a vegetable; Rochore, Pulau Ubin, Bukit Timah Road.

Lepisanthes rubiginosa (Roxb.) Leenh. (= *Erioglossum rubiginosum* (Roxb.) Bl.)

Tree, leaves odd-pinnate; leaflets 4-6 pairs, drooping; flowers small, male or bisexual, in terminal panicles; berry small, orange to black, with unpleasantly flavour. Pulau Ubin. Vern. *Mertajam.*

Euphoria malaiensis (Griff.) Radlk. (alt. names: **Nephelium malaiense** Griff. and **Dimocarpus longan** Lour.)

Tree; branches scurfy; leaflets 3-5 pairs, stalks finely tomentose; fruit glabrous, 1.5-2 cm across, brown with darker flecks; seed dark brown, shiny (cat's eye), pulp thin, sweet. Sometimes cultivated as a fruit tree. The fruits are very similar to those of Longan or Dragon's eye (龍眼) (alt. names: *Nephelium longana* Lam. and *Euphoria longan* Steud.) imported from S. China, but smaller (less than 2 cm across). Vern. *Mata kuching.*

Guioa pubescens Radlk.

Small tree; leaves odd-pinnate; leaflets 3-5 pairs; flowers small, white, in axillary spikes; fruit pink to red, 2-3 lobed, splitting; seeds with orange aril. Variable, hardly distinguishable from the allied species such as *G. bijuga* Radlk., *G. pleuropteris* Radlk., etc. Common, Bukit Timah, Water Catchment Area, Pulau Merlimau (*Sinclair 10772*).

Litchi chinensis Sonn. (alt. name **Nephelium litchie** Camb.)

The litchi tree is native to S. China, occasionally cultivated locally, but seldom flowers and still more rarely fruits. Imported fresh fruits can be found in markets around June or July. 荔枝

Mischocarpus pentapetalus (Roxb.) Radlk. (= *M. sumatranus* Bl.)

Shrub or small tree, rambutan-like; leaflets 3-6 pairs; fruit pear-shaped, about 2 cm long; 3-lobed, splitting; seeds large, brown, with a thin red aril. Bukit Timah, Pulau Ubin, Bukit Panjang (*Ridley s.n.*, in 1894).

Nephelium eriopetalum Miq.

Tree; leaves even-pinnate, with brown velvety stalks; leaflets 3-7 pairs; flowers white, in hanging spikes; fruit scarlet, like rambutans. Vern. *Lotong.* Gardens' Jungle, Bukit Timah. No specimens available.

Neph. glabrum Noronh.

Leaflets 1-2 pairs; fruit red, with small compressed knobs or wrinkled. Verb. *Redan.* Tanglin, Chua Chu Kang, Tuas.

Neph. lappaceum L.

Bushy tree; crown dense, rounded, spreading; leaflets 2-4 pairs; flowers greenish white, fragrant, without petals; fruit red (or some variety, yellow), 3-4 cm across, densely covered with soft spines; seed large, with a thick juicy sweet aril. Widely cultivated, one of the best known fruit trees. Vern. *Rambutan.*

Neph. mutabile Bl.

Bushy tree; branches spreading; leaflets 2-4 pairs, whitish below; fruit broadly ovoid, 4-5 cm long, crimson to dark purple, with short blunt spines; pulp pale yellow. Occasionally found in villages and orchards. Vern. *Pulasan.*

Neph. rubescens Hiern.

Tree; leaflets 3-6 pairs, whitish below; flowers with 5 pinkish petals; fruit oblong, 2.5 cm long; with short compressed spines. Chua Chu Kang.

Paranephelium macrophyllum King

Tall tree; leaves pinnate, 40-50 cm long; leaflets 5-9; flowers pinkish, panicled; fruit a woody spiny, 3-valved capsule; seeds large, brown, without pulp. In dense forests, Bukit Timah.

Pometia pinnata Forst. (= *P. alnifolia* Radlk.)

Small tree; leaves odd-pinnate, 50-100 cm long; leaflets 12-20 pairs, the lowest pair of leaflets much reduced, stipule-like; flowers male and bisexual, small, in hanging panicles; fruit oblong, with thin rind and one pulpy seed. In forests, Chua Chu Kang, Bukit Timah, Mandai (*Kiah 37114*), Tanglin.

Trigonachras acuta Radlk.

Tree; leaves pinnate, 10-20 cm long; leaflets 4-8 pairs; flowers white, in terminal panicles; fruit pear-like, 3-shouldered, 4-5.5 cm long, pinkish yellow to orange red. Tanglin, Bukit Timah (*Md. Noor 230*), rare.

Xerospermum intermedium Radlk.

Small tree; leaves pinnate, 10-20 cm long; leaflets 1-2 pairs; flowers white, in terminal and axillary racemes; ovary 2-loculate; fruit yellow, roughened with short tubercules, obovoid, 3 cm long; the seed enclosed in an edible pulp. Tanglin, Bukit Mandai. No specimens available. Vern. *Rambutan pachat.*

99. Staphylleaceae

Turpinia sphaerocarpa Hassk. (= *T. latifolia* Wall.)

Tree, briefly deciduous; leaves pinnate, 30-40 cm long; leaflets 5; flowers green, in large lax panicles; fruit fleshy, globose, green. In forests, Bukit Timah, Tanglin, Bukit Mandai, Seletar (*Ridley 3650*).

100. Balsaminaceae

Impatiens balsamina L.

The garden balsam is an annual herb, native to S.E. Asia. Flowers white, pink, purple or variegated, with a distinct spur; usually 1-3 flowers together in leaf-axils. Ovary woolly. Fruit elliptic, acuminate at apex, bursting into 5 coiled valves upon slight touch when ripe. 鳳仙花

Imp. sultani Hk. f.

Succulent herb flowers reddish purple, rarely white; peduncles 2-flowered. Ovary glabrous. Native to tropical Africa, sometimes cultivated.

101. Anacardiaceae

Key to the genera

A. Leaves simple

B. Leaves opposite — *Bouea*

B. Leaves alternate, often spirally arranged

C. Calyx cap-like, caducous; petals caducous or persistent and enlarged into fruit wings — *Gluta* (incl. *Melanorrhoea*)

C. Calyx usually persistent, 4-5 lobed

D. Petals persistent, usually enlarged into reflexed fruit wings — *Swintonia*

D. Petals deciduous

E. Fruit kidney-shaped, seated at the end of the fleshy swollen end of flower stalk — *Anacardium*

E. Fruit without an enlarged stalk

F. Fruit incompletely 2-loculate; seed curved — *Campnosperma*

F. Fruit l-loculate; seed straight

G. Fruit with 3-5 stigmas or vestiges of aborted carpels at the side or base — *Buchanania*

G. Fruit with 1 stigma

H. Fruit glabrous, fleshy, juicy, without black varnish — *Mangifera*

H. Fruit hairy, fleshy, thin and full of black varnish — *Melanochyla*

A. Leaves odd-pinnate

I. Leaflets with distinct intra-marginal veins — *Spondias*

I. Leaflets without intra-marginal veins

J. Calyx much enlarged and forming 4 red wings on the fruit — *Parishia*

J. Calyx not enlarged in fruit (rarely formed) — *Lannea*

Anacardium occidentale L.

The cashew-nut tree is a small tree, indigenous to S. America and the West Indies, often cultivated in sandy soil near the sea. The fruit is nut-like, borne on a juicy enlarged pedicel. The roasted seeds are eaten.

Bouea macrophylla Griff.

Tree; leaves 15-30 by 5-8 cm, opposite, simple; flowers small in axillary panicles. Fruit like a small mango, yellow, used as ingredient for *sambal.* In lowland forests, (*Cantley's collector, s.n.,* no precise locality), sometimes cultivated. Vern. *Kundang.*

Bouea oppositifolia Meisn. (= *B. microphylla* Griff.)

Small tree, leaves smaller than the above species, usually 2-15 by 1-5 cm. Bukit Timah (*Corner 34949*). Vern. *Rumenia.*

Buchanania arborescens (Bl.) Bl. (= *B. lucida* Bl.)

Tree; leaves leathery, blunt; flowers white. In open country and forests, Tanglin, Chua Chu Kang (*Goodenough 1882*), Changi, Kranji, Seletar. Vern. *Otak Udang.*

Buch. sessilifolia Bl.

Tree, leaves papery, with a prominent tip. In forests, Reservoir Jungle (*Corner s.n.,* in 1937), Chua Chu Kang, Tampines, Jurong.

Campnosperma auriculatum (Bl.) Hook. f.

Large tree; leaves large, 15-50 cm long, obovate, the apex blunt, often notched; the base with a pair of small ear-like lobes. Flowers in a scurfy panicle. Common in forest openings, forest margins, and secondary forests. Tuas (*Ridley 1880*). Vern. *Terentang.*

Campn. squamatum Ridl. (= *C. minor* Corner)

Tree, leaves smaller than the above species, 10-25 cm long; ear-like lobes absent. In secondary forests, less common, Nee Soon (*Md. Shah & Ali 4109*).

Gluta renghas L.

Large buttressed tree with a dense crown, introduced from N. Malaya, planted in Institute of Education Campus in Bukit Timah. This is the well-known *East Coast Rengas* tree, containing a watery resinous sap which blackens when exposed to the air. This sap can cause painful blisters on the skin.

Gluta wallichii D. Hou (= *Melanorrhoea wallichii* Hook. f., *M. woodsiana* Scort. ex King).

Large tree, bark fissured. Leaves obovate. Fruit a round nut crowned with 5 rose-red wings formed by the persistent petals. This is *Wallich's Rengas* tree, containing toxic sap, commonly found in Bukit Timah forest and in Water Catchment Area *(Md Shah & Md Ali 3921).*

Lannea coromandelica Merr. (= *L. grandis* Dennst.)

Deciduous tree; leaves pinnate, leaflets 7-13; flowers greenish, in slender racemes. Native to India, at one time ago planted as a roadside tree in Singapore.

Mangifera caesia Jack.

Tree; leaves simple; petioles short, broad, flattened. Flowers pale lilac, in pinkish panicles. Mangoes pale brown, bomb-shaped, edible. Jurong (Changi *Sinclair 40032*), Vern. *Binjai*.

Mang. foetida Lour.

Large tree, leaves often blunt, leathery; petioles short. Flowers scentless, pink, in reddish brown panicles. Mangoes oblong, plump, ripening green. Pulau Tekong (*Ridley 1810*), Vern. *Bachang*.

Mang. griffithii Hk. f. (= *M. microphylla* Griff. ex Hk. f.)

Big tree; leaves small (5-20 cm long); flowers yellowish white, in hairy panicles. Ripe mangoes red, 2-2.5 cm long. Bukit Timah (*Corner 34999*), Changi.

Mang. indica L.

Large tree. The Indian mango is commonly cultivated. Flowers yellowish white, in large panicles. Ripe fruit mostly yellow, sometimes orange or pinkish; many varieties. 檬果

Mang. lagenifera Griff.

A large tree; flowers deep violet; ripe mangoes greyish or brownish green, pear-shaped, sour and stringy. Jurong (*Ridley 4777*). Vern. *Langut*.

Mang. odorata Griff.

Large tree. Leaves pointed, thin leathery; flowers pink, fragrant, in, reddish brown panicles. Ripe mangoes oblong, plump, green to yellowish green with brown dots, edible, Bukit Timah (*Ridley 4773*), Vern. *Kwini.*

Melanochyla auriculata Hook. f.

Big tree; branches upright; leaves stiff, upturned at the end of branchlets; flowers green, in panicles. Fruit round, fleshy. In swampy forests, Chua Chu Kang (*Ridley 3975*), Kranji, Mandai.

Melan. kunstleri King

Tree. Leaves narrowed at the base; fruit broadly ovoid. Mandai (*Corner 37128*).

Parishia insignis Hook. f. (= *P. pubescens* Hook. f.)

Lofty tree; leaves pinnate; leaflets 9-17, opposite, the base oblique; flowers in large, rusty panicles. Fruit a hairy nut, surrounded by 4-wings formed by the persistent, enlarged sepals. Dalvey Road, Bukit Timah (*Samsuri 1245A*).

Par. paucijuga Engl.

Tree. Leaflets 4-11, the base symmetric. Bukit Timah (*Ngadiman 36451*).

Spondias cytherea Sonn.

Tree; leaves pinnate; leaflets 4-10 pairs; flowers small, stalked, greenish white, in panicles. Fruit oblong, ripening yellow or orange (4-10 by 3-8 cm). Native to Indo-Malayan regions, often cultivated for the edible fruit. Vern. *Kedondong.*

Spond. pinnata Kurz

Like the above, but leaflets 2-8 pairs and fruit smaller (3-5 by 2.5-3.5 cm). Cultivated for the fruit. Vern. *Kedondong.*

Swintonia schwenkii T. & B.

Large tree; leaves elliptic, simple. Fruit surrounded by 5 enlarged reflexed wings formed by the persistent petals. Rare, Bukit Timah (*Ngadiman 37705*).

102. Sabiaceae

Key to the genera

A. Trees; stamens 5, unequal — *Meliosma*

A. Climbers; stamens 4-5, equal — *Sabia*

Meliosma simplicifolia (Roxb.) Walp. (= *M. elliptica* Hook. f.)

Tree; leaves simple, flowers small, in large, branched terminal panicles. Chua Chu Kang (*Ridley s.n.*, in 1894).

Mel. lanceolata Bl.

Small tree; leaves pinnate; leaflets 13-17, rusty hairy beneath; flowers without a stalk. Chua Chu Kang, Jurong, Bukit Timah, Nee Soon (*Sinclair 40518*).

Mel. pinnata Maxim. ssp. **ridleyi** (King) Bens. (= *M. ridleyi* King)

Like the above species, but flowers stalked. Gardens' Jungle, Bukit Timah (*Haniff s.n.*, Sept. 1925).

Sabia erratica v.d. Water

Climbing shrub; leaves simple, entire; flowers axillary. Bukit Timah (*Ngadiman KEP 36149*, Type).

103. Icacinaceae

Key to the genera

A. Trees or shrubs, erect

B. Trees

C. Leaves scaly beneath, appearing glaucous; flowers unisexual, in spikes — *Platea*

C. Leaves not scaly beneath; flowers bisexual, in cymes — *Stemonurus*

B. Shrubs

D. Flowers unisexual, in cymes; sepals nearly free — *Gomphandra*

D. Flowers bisexual, in spikes; sepals united — *Gonocarpum*

A. Woody climber

E. Leaves opposite; fruit scarlet, not forming a head — *Iodes*

E. Leaves alternate; fruit, yellow, many together in a large ball — *Phytocrene*

Gomphandra quadrifida (Bl.) Sleum. var. **lanceolata** Sleum. (= *G. affinis* Mast.)

Shrub; leaves alternate; flowers in cymes, crowded into heads; fruit ribbed, crowned by a large persistent stigma. In woods. Chua Chu Kang, Bukit Timah (*Ridley s.n.*, in 1892).

Gonocaryum gracile Miq. (= *G. longiracemosum* King)

Large straggling shrub; flowers purplish green, in pendulous axillary spikes; fruit purplish green, obtusely 5-6 ridged. In forests, Tanglin, Gardens' Jungle (*Samsuri 986*), Changi.

Iodes ovalis Bl. (= *I. oblonga* Planch.)

Deciduous climbing shrub; leaves opposite; flowers in axillary cymes; petals in male flowers 5, free. Fruit scarlet. In borders of forests, Changi, Gardens' Jungle, Chua Chu Kang. No specimens available.

Iodes velutina King

Shrub. Petals in male flowers white, united into a tube. Rare, Bukit Timah (*Ridley 2718*).

Phytocrene bracteata Wall.

Large woody climber; stem prickly and hairy; flowers unisexual, small, in dense racemes arising from stem above leaf scars. Drupe covered with brown bristles and forming a large ball. In forests, Bukit Timah, Cluny Road (*Sidek 1191*).

Platea latifolia Bl.

Tree; leaves alternate, the under surfaces covered with short hair and scales giving a pale bluish grey colour. Flowers unisexual, in short spikes (♂) or cymes (♀). Drupe ellipsoid. Seletar (Collector unknown, *Herb. Acc. no. 027599*).

Stemonurus malaccensis (Mast.) Sleum. (= *S. capitatus* Becc.)

Tree; leaves alternate, leathery. Flowers white, in axillary, cymose clusters crowded at the end of peduncles. Drupe large, fleshy, subovoid, slightly pointed, 4-5 cm long, pink or pale brown. Seletar.

Stem. scorpioides Becc.

Large tree; flowers close together in a row on each side of the axis. Fruit-pointed at both ends. Seletar, Bukit Mandai (*Ridley 1837*).

104. Olacaceae

Key to the genera

A. Slender woody climbers — *Erythropalum*

A. Trees or shrubs, erect

B. Inland trees, rarely shrubs, not spiny

C. Twigs (especially the young ones) zigzag; flowers in clusters; fruit enclosed in receptacle — *Strombosia*

C. Twigs straight; flowers in short racemes or long spikes

D. Tertiary veins on leaf-blades faint; trees not reeking of garlic; flowers in long spikes — *Ochanostachys*

D. Tertiary veins conspicuous; trees reeking of garlic; flowers in short racemes — *Scorodocarpus*

B. Sandy shore shrubs in small trees, spiny — *Ximenia*

Erythropalum scandens Bl.

Slender woody climber; flowers green, in long racemes; fruit orange red, enclosed in persistent bright red calyx, ultimately split into 4 parts. In forests, Catchment Area, Bukit Mandai, Nee Soon (*Samsuri 1507*).

Ochanostachys amentacea Mast.

Small to medium-sized tree; leaves elliptic-ovate, with fine ladder-like tertiary nerves; flowers green, in simple or branched spikes. A well-known timber tree. Gardens' Jungle, Changi (*Ridley 4653*), Catchment Area. Vern. *Petaling.*

Scorodocarpus borneensis Becc.

Large timber tree, cut parts reeking of garlic; leaves oblong-elliptic, tertiary veins ladder-like; flowers white, in short racemes. Gardens' Jungle, Bukit Timah (*Sinclair 39572*) Vern. *Kulim.*

Strombosia javanica Bl.

Medium-sized tree; branches drooping; leaves oblong, 10-12 cm long, tertiary veins visible; flowers 1-3, in leaf-axils. Fruit ovoid, 2 cm long. In forests, MacRitchie Reservoir (*Sinclair 10919*).

Stromb. ceylanica Gardn. (= *S. rotundifolia* King)

Small tree. Leaves smaller than (9-11 cm long) the above species, tertiary veins obscure. In forests, Bukit Timah, Bukit Mandai, Jungle, Changi (*Ridley 4744*).

Ximenia americana L.

Spiny shrubs or small trees; flowers white; drupe orange, edible. Pantropical, probably of American origin. On sandy shores, Changi, Jurong, Pasir Panjang, Pulau Seletar.

105. Santalaceae

Key to the genera

A.	Scandent shrubs; semi-parasitic; flowers minute, in clusters	*Dendrotrophe*
A.	Spiny trees; autotrophic; flowers in long spikes	*Scleropyrum*

Dendrotrophe buxifolia (Bl.) Miq. (= *Henslowia buxifolia* Bl.)

Scandent shrub; leaves leathery, obovate or rounded, yellowish green, 3-nerved from the base; flowers green, minute, in clusters. In open places and forests, often near the sea, Chua Chu Kang, Kranji (*Ridley s.n.*, in 1894), Changi.

Scleropyrum wallichianum Arnott var. **ridleyi** (Gamble) Stauffer (= *S. ridleyi* Gamble)

Small spiny tree; leaves ovate to oblanceolate, white tomentose beneath; flowers unisexual, in spikes, tomentose. Drupe pear-shaped green, 6-7 cm long. In dry forests near the sea. Changi (*Ridley 1921,* Type), Seletar, Bukit Mandai.

106. Opiliaceae

Key to the genera

A.	Climbing shrubs; leaves 3-5 nerved from the base; flowers in dense axillary spikes	*Cansjera*
A.	Erect shrubs; leaves pinnately nerved	
B.	Flowers in panicles of small cymes	*Champereia*
B.	Flowers separate or in clusters	*Lepionurus*

Cansjera rheedii J. F. Gmel. (= *C. zizyphifolia* Griff.)

Climbing shrub; leaves ovate, 3-5 nerved from the base, rather fleshy; flowers small; drupe red, globose. Bukit Timah (*Corner s.n.*, Apr. 1943).

Champereia manillana (Bl.) Merr.

Shrub; leaves ovate-oblong or lanceolate; flowers green, small, in lax slender panicles; drupe ellipsoid, orange. In forests, MacRitchie (*Samsuri 1332*).

Lepionurus sylvestris Bl.

Shrub; leaves oblong to elliptic; flowers in dense spikes; drupe oblong, red. Gardens' Jungle (*Ridley 10124*), Bukit Panjang, Changi.

107. Loranthaceae

Key to the genera

A. Flowers unisexual, less than 4 mm long; leaves present or reduced to minute scales *Viscum*

A. Flowers bisexual, usually over 1 cm long; leaves present

B. Flowers 4 to 5-merous, subtended by 1 bract at the base

C. Flowers 4-merous; perianth zygomorphic, the segments reflexed to one side *Scurrula*

C. Flowers 5-merous

D. Perianth-lobes free or only slightly cohering at the base *Helixanthera*

D. Perianth-lobes connate *Dendrophthoe*

B. Flowers 6-merous; perianth-lobes connate

E. Flowers subtended by a cup-shaped bract at the base *Amylotheca*

E. Flowers subtended by 1 bract and 2 bracteoles

F. Flowers sessile on thickened nodes of the rachis below the leaves *Elytranthe*

F. Flowers usually pedicelled, not as above *Macrosolen*

Amylotheca duthieana (King) Danser (= *Loranthus duthieanus* King)

Semi-parasitic shrub; branches glabrous, stout; leaves alternate, opposite or whorled; racemes slender, 5-6 cm long; perianth-tube ('corolla') bright red, 6-lobed. Rare, Bukit Timah (*Ridley s.n.*, in 1892).

Dendrophthoe pentandra (L.) Miq. (= *Loranthus pentandrus* L.)

Large bushy shrub; leaves mostly a ternate, thick, oval to elliptic; flowers light pinkish red, in short axillary racemes. A pest in gardens and orchard, often on *Eugenia* trees; Bukit Timah, Chua Chu Kang.

Elytranthe albide Bl.

Stout glabrous shrub; leaves opposite; flowers in 2-6 flowered, distichous spikes on thickened nodes below the leaves. On high trees, in forests, Bukit Timah (*Ridley 8042*).

Elytr. arnottiana (Korth.) Miq. (= *E. maingayi* Gamble)

Scurfy shrub in coastal forests by mangroves, Kranji (*Ridley 6923*).

Helixanthera coccinea (Jack) Danser (= *Loranthus coccineus* Jack)

Much branched bush; young stems reddish scurfy-tomentose; leaves oval to round, alternate; racemes bright red; berry flask-like, reddish brown. Bukit Mandai (*Mat 6697*).

Macrosolen cochinchinensis (Lour.) Tiegh. (*Elytr. globosa* Don)

Much branched shrub, glabrous; leaves ovate or lanceolate, opposite or nearly so; flowers yellow, tipped purple in short axillary racemes. Berry yellowish. Common, Tanglin, Chua Chu Kang (*Ridley 2022*), Bukit Timah.

Macr. retusus (G. Don) Miq. (= *Elytr. retusa* G. Don)

Stout shrub; leaves thick, obovate to elliptic, opposite; flowers light pink, tipped red, racemes 1.5-2.5 cm long. On *Rhodomyrtus* trees near the sea, Changi, (*Ridley 1808*), Pulau Tekong.

Scurrula ferruginea (Roxb.) Danser (= *Loranthus ferrugineus* Roxb.)

Slender bush; young parts inflorescences, and leaf under-surfaces densely covered with reddish scurf; leaves elliptic, opposite; flowers 2-6, in axillary cymes. Berry club-shaped. An orchard pest; often parasitic on *Melastoma* and many other trees; Tanjung Penjuru Road (*Md. Shah SFN 40974*).

Viscum articulatum Burm. f. (= *Aspidixia articulata* Tiegh.)

A leafless shrub, parasitic on other loranthi; flowers 4-merous, unisexual; fruit ellipsoid, less than 1 cm long. Tanglin, Chua Chu Kang (*Ridley 8054*).

Viscum ovalifolium Wall. ex DC. (= *Viscum orientale* Auct. *non* Willd.)

Shrub; leaves opposite, obovate; flowers 1-3, very small, in axillary clusters. Parasitic on *Ficus, Macaranga* and other trees, Gardens' Jungle, Chua Chu Kang (*Ridley 6816*).

108. Cornaceae

Key to the genera

A. Leaves alternate; flowers over 1 cm long

B. Leaves entire; sepals and petals 4-10 *Alangium*

B. Leaves varying from entire, coarsely toothed, incised to pinnately lobed; sepals and petals 5 *Aralidium*

A. Leaves opposite; flowers small, less than 5 mm long *Mastixia*

Alangium ebenaceum (Clarke) Harms var. **tutela** (Ridl.) Kochum.

Medium tree; twigs white smooth; leaves oblong, rarely elliptic, 15-25 cm long, glabrous; fruit ellipsoid, faintly ridged. Ponggol (*Goodenough 5082,* Type).

Alang. nobile Harms

Small tree. Leaves oblong or obovate, 3-nerved from the heart-shaped base, densely hairy beneath. Bukit Timah (*Ngadiman 34601*).

Alang. ridleyi King

Large tree. Leaves oblong, 20-30 cm long; flowers white; fruit purple. Gardens' Jungle, Bukit Timah (*Ngadiman 36136*).

Aralidium pinnatifidum Miq.

Unarmed small tree; leaves varying from entire, coarsely toothed, incised to pinnately lobed; flowers relatively small (0.25 cm long), in terminal panicles. Kranji (*Ridley 5895*), Bukit Timah, Jurong.

Mastixia trichotoma Bl. var. **maingayi** Danser (= *M. maingayi* Clarke)

Large tree; leaves opposite, woolly below; flowers small, in cymose panicles. Gardens' Jungle, Reservoir Jungle (*Corner s.n.,* 10 Dec. 1940).

109. Araliaceae

Key to the genera

A. Leaves simple, pinnately lobed or compound

B. Trees in secondary forests; leaves (at least the lower ones) odd-pinnate, with 12-14 pairs of leaflets *Arthrophyllum*

B. Shrubs in cultivation; leaves simple, compound (with 3-5 leaflets) or 2-3 times compound *Polyscias*

A. Leaves palmately lobed or compound, rarely simple

C. Mostly epiphytic shrubs, stout or slender; leaflets 3-14 *Schefflera*

C. Shrubs, erect; leaves palmately 7-12 lobed but connected by a webbed fan-like base *Trevesia*

Arthrophyllum diversifolium Bl.

Small to medium tree; leaves very diverse: the lower ones of vegetative shoots odd-pinnate, spiral, 100-200 cm long with 12-14 pairs of leaflets, the upper ones of flowering shoots opposite or whorled, with smaller and less numbered leaflets, often 3-foliolate or simple; flowers green, in branched umbels. Fruit black. Common in secondary forests, forest margins, Changi (*Ridley 5838*), Catchment Area, Bukit Timah.

Polyscias fruticosa Harms (= *Nothopanax fruticosum* Miq.)

Shrub, 2-3 m tall; leaves to 30 cm long, 2-3 times pinnate; leaflets irregularly lanceolate, often toothed; occasionally flowering. Native to Polynesia, sometimes cultivated.

Pol. guilfoylei Bailey (= *Nothopanax guilfoylei* Merr.)

Shrub, 2-6 m tall; leaves pinnate, of 5-7 ovate leaflets which are toothed or laciniate, white-spotted or margined. Native to S. Polynesia.

Pol. scutellaria Fosb. (= *Nothopanax scutellarium* Merr.)

Shrub, 2-6 m tall; leaves unifoliolate, rounded (cv. *scutellaria*) or simple pinnate with 3 or 5 nearly rounded leaflets (cv. *pinnata*), subentire, toothed, variously shaped, green. Native country unknown, often cultivated.

Schefflera actinophylla Harms (= *Brassaia actinophylla* Endl.)

Native to N. Guinea and Australia. Terrestrial of epiphytic shrub; leaves palmately compound; leaflets about 15. Native to New Guinea and Australia, a common pot plant, known as 'Octopus tree' or 'Umbrella tree'.

Scheffl. cephalotes (C. B. Clarke) Harms

Stout climbing epiphytic shrub; leaflets about 8. Sungei Bajau (*Ridley 3973*).

Scheffl. elliptica (Bl.) Harms (= *S. micrantha* Ridl.)

Woody climber or straggling shrub; leaflets 4-6 in mangroves. Kranji.

Scheffl. hullettii (King) Viguier

Large stout shrub, climbing; leaflets 9-11. Seletar (*Corner s.n.*, June 1944).

Scheffl. lanceolata Ridl.

Slender epiphytic climber; leaves simple or 3-foliolate; in mangroves, Kranji (*Ridley 5840*).

Scheffl. oxyphylla (Miq.) Viguier (= *S. subulata* (Miq.) Viguier)

Slender epiphytic creeper; leaflets 3-5. Chua Chu Kang, no specimens available.

Scheffl. ridleyi (King) Viguier

Epiphytic shrub, sometimes straggling; leaflets 5. In mangroves, Sungei Morai (*Ridley 6336*, Type).

Trevesia burckii Boerl. (= *T. cheirantha* Ridl.)

Prickly shrub; leaves large, palmately lobed or palmatisect with a webbed fan-like base; flowers unisexual; in panicles formed by umbels; flower parts 7-12. Collected once at Bedok (*Ridley s.n.*, in 1899), now extinct.

110. Umbelliferae

Key to the genera

A. Creeping herbs; leaves not spiny

  B. Leaves crenate, reniform; mericarp 7-9 ribbed *Centella*

  B. Leaves nearly entire, lobed or divided, rounded in outline; mericarp 3-ribbed *Hydrocotyle*

A. Erect herb; leaves spiny *Eryngium*

Centella asiatica Urb (= *Hydrocotyle asiatica* L.)

Creeping herb, very variable; leaves reniform with toothed margin; flowers 2-3 in a cluster; half-fruit 7-9 ribbed. Common in wet grassy places, Tuas (*Ridley 343*); used in local medicine; also eaten as a vegetable, raw or cooked.

Eryngium foetidum L.

A prickly erect herb with a strong odour; leaves all from the base of stem, with spiny teeth; flowering shoot branched, with thick, spiny bracts in groups of 4-5, groups at intervals. A native of the West Indies, sometimes used locally to flavour food.

Hydrocotyle sibthorpioides Lamk. (= *H. rotundifolia* Auct. *non* Roxb.)

Tiny creeper; leaves rounded in outline, the margin lobed or divided; flowers 5-15 on a obliquely erect stalk; fruit schizocarpous, half-fruit 3-ribbed. Often in flower pots or other damp places. Botanic Gardens (*Purseglove 4064*).

(to be continued)

OBITUARY

KEE CHIN HIN
1938 to 1982

Mr Kee Chin Hin, late Commissioner of the Parks & Recreation Department – a man with the gift of making lifelong friends at first acquaintance, whose warmth, friendliness and genuine interest in people touched all who knew him. His was the boundless enthusiasm for work, for play, which caught and motivated his friends, colleagues and subordinates; his, the ever bubbling spring of ideas which guided and made us strive for greater achievements. His death, a time to ponder on God's will – why someone so alive and full of zest to live, should be wrenched from life so suddenly on 12 April 1982.

Kee Chin Hin was born on 11 April 1938. He embarked on an early career as a teacher and obtained a Certificate in Education in 1962 with a distinction in Science. He went on to pursue a Science Degree at the University of Singapore and graduated with Honours in Zoology in 1968. He joined the Primary Production Department in the same year and was soon assigned the task of re-organising the Jurong Fishing Port/Central Fish Market and within a short period of time he achieved the transfer of all the small auction markets in the City area to the Central Fish Market and made it into a flourishing centre. In recognition of this work he was awarded the Efficiency Medal in the 1970 National Day Honours.

Having proven himself to be a good administrator, Mr Kee was, in addition to his duties in the Primary Production Department given the responsibility of co-ordinating the activities of the Garden City Action Committee of the Ministry of National Development. This work was tackled with characteristic efficiency and enthusiasm and he was consequently seconded to the Parks & Recreation Division PWD when it was formed in 1973. In the same year also did he obtain his Diploma in Business Administration from the same University. In his capacity as Assistant Commissioner in the Parks & Recreation Department, in charge of Planning and Development, he did much outstanding work in the implementation of development programmes for the construction of our major parks, the

most notable of which being East Coast Park. He was awarded the Public Administration Medal (Bronze) in the 1976 National Day Honours. Mr Kee's drive and guidance to the Department never wavered throughout his service and he rose to hold the position to Commissioner of Parks & Recreation in February 1982. He was honoured posthumously with the Silver Medal for Public Administration on National Day.

Mr Kee was also instrumental in founding the School of Ornamental Horticulture, which celebrated its tenth anniversary this year. The School is serving an important function in providing Singapore and the regional countries with expertise much needed in tropical horticulture. In addition to being Chairman of the School Board, Mr Kee was at the time of his death, also a Trustee of the Nature Reserves Board, Director of Primary Industries Enterprise (Pte) Ltd, Member of the Executive Committee of Sembawang Country Club and Vice-President of the Ministry of National Development Recreation Club.

Mr Kee's enthusiasm and involvement in his work for the Parks & Recreation Department knows no parallel and no other officer can lay as much claim to having been so closely involved with or having contributed so much to Singapore's Garden City Campaign.

Kee Chin Hin leaves behind his wife, Margie, and two daughters, Adeline and Yi Li. We share the pain and grief for their loss.

Parks & Recreation Department

INSTRUCTIONS TO AUTHORS

Manuscripts: The Editorial Committee of the Gardens' Bulletin will be glad to receive and consider for publication original research findings and reviews of progress in the fields of botany, horticulture, and allied subjects. Contributions must be original and the material must not have been submitted or, if accepted, be submitted for publication elsewhere.

Two copies of the manuscript should be submitted, typed on one side only with double-line spacings and a margin of at least 4 cm. Authors should see the layout of other papers recently published in this journal to ensure that papers submitted conform as closely as possible to the accepted pattern. Numerical data should only be included if it is essential to the argument and this can be presented either in the form of tables or diagrams.

Title and authors: The title should give a concise description of the contents of the papers. The name(s) of author(s) and address(es) must be given below the title. Lengthy papers and those of a taxonomic nature must have the contents listed at the beginning of the paper.

Scientific names: The complete scientific name – genus, species, authority, and cultivar where appropriate – must be cited for every organism at time of first mention. The generic name may be abbreviated to the initial thereafter except where intervening references to other genera with the same initial could cause confusion.

Tables: All tables should be numbered and carry headings describing their content. These should be comprehensive without reference to the text.

Abbreviations: Standard chemical symbols may be used in the text (e.g. IAA, IBA, ATP), but the full term should be given on the first mention. Dates should be cited as: 3 May 1976. Units of measurement should be spelled out except when preceeded by a numeral where they should be abbreviated in standard form: g, mg, ml, etc. and not followed by stops.

Literature citations: Citations in the text should take the form: King and Chan (1964). If several papers by the same author in the same year are cited, they should be lettered in sequence (1964a), (1964b), etc. When papers are by up to three authors, all the names should be recorded; otherwise a reference with more than three authors should be cited as: Geesink et al. (1981). All references must be placed in alphabetic order according to the surname of the (first) author and in the following form:

Lawson, R. H. (1970). Flower Necrosis in *Cattleya* Orchids. *Am. Orchid Soc. Bull.* 39, 306-312.

Singh, H. (1967). Sclerids in *Fagraea. Gard. Bull. Sing.* 22:2, 193-212.

Abbreviations of titles of journals should be those of the World List of Scientific Periodicals (4th Edition) or the Selected Abbreviated Titles of Biological Journals (London: Institute of Biology).

References to books and monographs should be cited according to the following form:

Ridley, H. N. (1930). *The Dispersal of Plants Throughout the World.* L. Reeve; Ashford, Kent; 242-255.

For literature citations in taxonomic papers the following style is required:

Medinilla alternifolia Bl., Mus. Bot. Lugd.-Bat. I:2 (1849) 19.

Sterculia acuminatissima Merr., Philip. J. Sci. 21 (1922) 524.

Illustrations: Drawings should be done in India ink and all photos should preferably be submitted in the form of glossy prints. Authors should indicate where individual illustrations receive first mention in the text.

Offprints: Authors will be given 50 offprints gratis. Additional copies must be ordered and paid for, prior to publication.

Manuscripts should be sent to: THE EDITOR, GARDENS' BULLETIN SINGAPORE, BOTANIC GARDENS, CLUNY ROAD, SINGAPORE 1025.

PUBLICATIONS OF THE BOTANIC GARDENS SINGAPORE

1. **The Agricultural Bulletin of the Malay Peninsula (Series I).**
   Only nos. 3, 5, 7, 8, and 9 available at 20 cents each.

2. **The Agricultural Bulletin of the Straits and F.M.S. (Series II).**
   Vols. 1–10, 1901–1911, monthly issues.
   Many parts available.
   Price: $5 per volume, 50 cents per part.

3. **The Gardens' Bulletin, Straits Settlements (Series III).**
   Vols. 1–11, 1912–1947.
   Vol. 1 (1–5) January-May 1912 issued under the title of **Agricultural Bulletin of the Straits & F.M.S.**

   Prices on application.

4. **The Gardens' Bulletin, Singapore (Series IV).**
   Vols. 13–32, 1949–1979.
   Price: Vol. 13 $20 per vol., Pt. I (new impression) $12 per copy; Vol. 14 $13 per vol.; Vol. 17 Pt. III $12.50; Vols. 18 & 19 $25 per vol.; Vol. 20 Pt. I $8.00, Pt. III $5.00; Vol. 21 Pt. II $5; Vols. 22-25 $25 per vol. Vol. 26 (Pt. I $18; Pt. II $18); 27 (Pt. I $18; Pt. II $18.50); 28 (Pt. I $18; Pt. II $15); 29 ($30); 30 ($48); 31 (Pt. I $10; Pt. II $12.50); 32 ($15.50); The Freshwater Swamp-forest of S. Johore and Singapore by E.J.H. Corner (Gard. Bull. Sing. Suppl. 1) – $35; Vol. 33 (Pt. I $21.50; Pt II $12.50; Index $1.90; Vol. 34 (Pt. I $21.50).

5. **Materials for a Flora of the Malay Peninsula, Monocotyledons.**
   Parts 1, 2 and 3 remain available.
   Price: $10 per set, $5 per part.

6. **Annual Reports.**
   1909–1972.

7. (a) **Malayan Orchid Hybrids by M. R. Henderson and G. H. Addison,** $15 (1969)
   (b) **Malayan Orchid Hybrids, Supplement I by G. H. Addison.** $21 (1961, out of print).

8. **A Revised Flora of Malaya.**
   (a) Vol. 1, Orchids by R. E. Holttum. $50 (3rd ed. 1980 Impr.)
   (b) Vol. 2, Ferns, by R. E. Holttum. $20 (2nd ed. 1968).
   (c) Vol. 3, Grasses, by H. B. Gilliland, $30 (1971).

9. *Boletus* **in Malaysia by E. J. H. Corner.** $50 (1972).

Items 1–6 obtainable from the Commissioner, Parks & Recreation Department, Botanic Gardens, Cluny Road, Singapore 1025; tel. nos. 4741165, 4741134.

Items 7–9 obtainable from Singapore National Printers (Pte) Ltd, Upper Serangoon Road, Singapore 1334; tel. no. 2820611

Prices quoted are in Singapore Dollars
Overseas postage is extra

ISSN 0374-7859

THE GARDENS' BULLETIN
SINGAPORE

VOL. XXXV (Part 2) 1st December 1982

CONTENTS

Published by the Botanic Gardens
Parks and Recreation Department
Ministry of National Development
Singapore 1025

Printed by Eurasia Press, Singapore

The Gardens' Bulletin is published twice yearly by the Parks & Recreation Department, Ministry of National Development, Singapore. Neither the Parks & Recreation Department nor the Editorial Committee is responsible for the opinions or conclusions expressed by the contributing authors.

The price of the Gardens' Bulletin varies according to the content of each issue. This issue is priced at Sing. $21.50 cts. excluding postage. Overseas subscribers are requested to make payment in the form of bank drafts or international money orders in Singapore currency payable to the *Commissioner of Parks and Recreation, Singapore.*

All correspondence concerning advertisements and exchange should be addressed to:

The Business Manager
Gardens' Bulletin
Botanic Gardens
Parks and Recreation Department
Singapore 1025

Instructions for contributing authors are found on the inside of the back cover.

THE GARDENS' BULLETIN
SINGAPORE

VOL. XXXV (Part 2) 1st December 1982

CONTENTS

Published by the Botanic Gardens
Parks and Recreation Department
Ministry of National Development
Singapore 1025

Effective – publication date: 1st March 1983

LET US TELL YOU WHY

PHOSTROGEN

IS THE BEST PLANT FOOD MONEY CAN BUY . . .

Over the years, trials and tests have been continually carried out by leading independent authorities in plant nutrition. These have proved, again and again, that only the unique PHOSTROGEN formulation and the high quality materials we employ produce the consistently outstanding results which have made PHOSTROGEN Britain's most recommended, most economical and most widely used all-purpose plant food. No other leading plant food or fertiliser manufacturer has the confidence to offer only one liquid/soluble plant food. We do because we know, and millions of highly satisfied users know, that when you use PHOSTROGEN you simply need no other plant food.

WE GUARANTEE NO OTHER PLANT FOOD IS SO VERSATILE GIVING SUCH OUTSTANDING VALUE FOR MONEY

COMPARE THE UNIQUE VERSATILITY OF PHOSTROGEN WITH ANY OTHER PLANT FOOD . . .

We print big and bold on our cartons exactly what PHOSTROGEN will do for you and provide a comprehensive leaflet inside to help experts and amateurs alike to achieve outstanding success.

Remember, PHOSTROGEN is recommended for root **and** foliar feeding everything that grows in the garden, greenhouse and home including tomatoes, lawns, roses, all pot plants, flowers, vegetables, fruit, shrubs and trees. It is also recommended for use with soil-less composts and growing bags, as a top dressing, for restoring impoverished soils and for hydroponics.

At a glance some plant foods may look the same as PHOSTROGEN, but they're not. You may find that there is no mention of tomatoes, lawns, pot plants, growing bags, foliar feeding, top dressing, impoverished soils or hydroponics which means that you are expected to buy expensive special plant foods for these. PHOSTROGEN saves you this need.

HOUSE PLANT FOOD

IN THE HANDY SPIKE PACK

PHOS-TRO-TABS PLANTOIDS are now available in this functional and attractive pack of 40 tablets designed to insert the tablets in the growing medium. For plants in pots, tubs, hanging baskets, etc. May be refilled from 100 tablet carton.

PHOSTROGEN

USE IT AND YOU NEED NO OTHER PLANT FOOD

Sole Agent:

GARDEN SUPPLIES CENTRE (PTE) LTD.

617, BUKIT TIMAH ROAD SINGAPORE 1026 TEL: 672821
BRANCH: PLOTS 11&12 JOAN RD (OFF THOMSON RD) SINGAPORE 1129 TEL: 2513131
TELEX: GARCEN RS 35451. CABLE: "LANDSCAPE"

PHOSTROGEN PRODUCTS ARE OBTAINABLE AT:

TANGS•EVERSHINE FLORIST•FAR EAST ORCHID•FLORAMIST•HANDY-MAN CENTRE•HANDY-TOOLS LTD
INTERNATIONAL DISPENSARY•JASON FLORIST•KATONG FLOWER SHOP•LES FLORIST•LIAN KHIONG TRADING
LOVE FLORIST•MELINA FLORIST•PET LOVERS' CENTRE•SINGAPORE ORCHIDS•SONG LANG GARDEN
SPA (PTE) LTD•SUNNY FLORIST•TERRA PTE LTD•VERONICA FLORIST (COLD STORAGE)

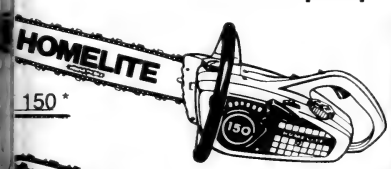
Chain saw buyers

WARNING

1. Don't settle for less than America's No.1 chainsaw.

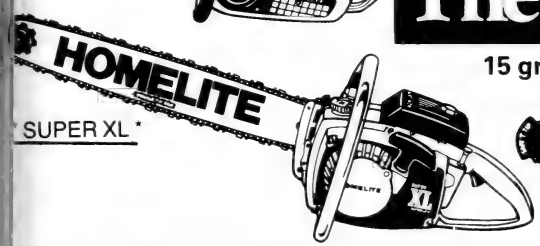
2. Don't be caught with cheapies and saws you have to throw away.

From the back woods to the backyard, people who know saws insist on



Homelite®. The Chain Saw King.

15 great models from 26cc to 112cc



versatility, quality, price and safety don't go past

HOMELITE®

A name you can depend on

Sole Agent: BRUNEI, MALAYSIA, and SINGAPORE

KIM SAN MACHINERY CO
478, SERANGOON ROAD
SINGAPORE 0821
Tel: 2929767, 2965916
Cable:KIMSANMAC

山林工運公司
SAN LIM TRANSPORT CO.

新加坡宏茂橋第十道大牌四〇一號門牌六〇五號 F

BLOCK 401, 605-F

ANG MO KIO AVENUE 10

SINGAPORE 2056

TEL: 2572671, 2578358

SERVICES OFFERED:

* PLANTING OF TREES & SHRUBS
* TURFING
* GRASS-CUTTING
* LANDSCAPE CONSTRUCTIONS

WE HAVE:

* COW GRASS FOR SALE

WE ARE EQUIPPED WITH

JCB, P&H 350, 955L, 977L

亞洲農業供應貿易公司
ASIATIC AGRICULTURAL SUPPLIES & TRADING CO.

186, 18KM CHUA CHU KANG ROAD
LOT NO. 36, COMFORT GARDEN
SINGAPORE 2368
TEL. NOS: 7695051, 7695052,
TELEX: RS 33406 A.A.S.T.C.

STRAIGHT, COMPOUND ORGANIC AND
FOLIAR FERTILIZERS FOR
ESTATES AND PLANTATIONS

TECHNICAL AND FORMULATED FUNGICIDES
FOR CONTROL OF FUNGAL DISEASES

TECHNICAL AND FORMULATED
INSECTICIDES FOR PEST CONTROL

TECHNICAL AND FORMULATED
HERBICIDES FOR WEED CONTROL

POWER AND MANUAL SPRAYING
EQUIPMENT AND WATER TREATMENT
CHEMICALS, SOLVENTS AND EMULSIFIERS

TROPICAL FISH FOODS, FINGERLING,
GROWER AND HOLDING PELLETS,
ALGAECIDES FOR PONDS,
AQUARIUMS ETC.
VETERINARY PRODUCTS.

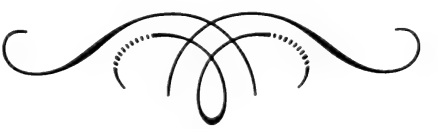
CHEW ANN ENG
CONSTRUCTION & TRADING CO.

BLOCK 402, 5H

PANDAN GARDENS

SINGAPORE 2260

TEL: 2641077



WE OFFER SERVICES IN:

CUTTING AND TRANSPLANTING

OF TREES

HAI JOO CONTRACTOR CO.

1214, UPPER THOMSON ROAD

SINGAPORE 2678

TEL: 4570055

4577054

We provide for all kinds of Horticultural work:

PLANTING

TURFING

MAINTENANCE OF

LANDSCAPE WORKS

Call At

SIN SWEE LEE

CONTRACTORS

17, THOMSON HILLS DRIVE

SINGAPORE 2057

TELEPHONE: 4528314

Services Offered:

GRASS CUTTING

TURFING

PLANTING & TRANSPLANTING OF TREES

GENERAL MAINTENANCE

PARKS AND RECREATION DEPARTMENT

PUBLICATION FOR SALE

	TITLE	PRICE PER COPY*
☐	Selected Plants & Planting for a Greener Singapore	$0.60
☐	Selected Plants & Planting for a Garden City — Forty Shrubs	$1.20
☐	Selected Plants & Planting for a Garden City — Forty Climbers	$3.00
☐	A Revised List of Plants for Sale	$0.30
☐	A Guide to the Aeration of Trees	$1.00
☐	Bukit Timah Nature Reserve	$0.60

Requests for the publications should be addressed to the Commissioner of Parks & Recreation, Maxwell Road, Singapore 0106, Republic of Singapore.

For overseas orders, payment should be by bank draft or International Money Order and made payable to the Commissioner of Parks & Recreation, Singapore.

* Prices quoted are in Singapore Dollars.
For overseas orders — postage extra.

Critical Observations on Peninsular Malaysian *Selaginella*

WONG KHOON MENG
Forest Research Institute, Kepong, Malaysia

Abstract

The genus *Selaginella* is represented in the Malay Peninsula by 28 species, including 3 varieties. Three species are here reinstated, 2 from varietal rank *(Selaginella scabrida* Ridl., *S. curtisii* Ridl.) and 1 from synonymy *(S. polita* Ridl.). Two varieties are validated, viz., *S. intermedia* var. *dolichocentrus* Wong and *S. roxburghii* var. *strigosa* (Ridl.) Wong. A key to the species and varieties is provided, and a description of each species is given. Habit, branching, leaf and sporophyll characteristics of the sporophyte plant are reviewed. Habitat preferences and various probable ecological adaptations towards efficient use of light and optimal reproduction are discussed.

Introduction

The genus *Selaginella* in the Malay Peninsula is represented entirely by species belonging to subgenus *Heterophyllum* Hieron. (characterised by dissimilar-sized leaves) which contains a larger number of species with predominantly tropical distribution, as opposed to subgenus *Selaginella* Baker (characterised by similar-sized leaves) which contains a smaller number of species found mainly in temperate regions.

Ridley (1919) gave the first account of the genus *Selaginella* in the Malay Peninsula; he listed 37 species of which 21 he considered possibly endemic. Alston (1934) revised the genus for the Peninsula, reducing the number to 25, treating 6 as endemic and considered that there was quite a range of variation especially with regard to leaf size. By the time his account of the Sumatran species was published in 1937, he had amended the names of 4 of these species *(S. peltata* Presl to *S. caulescens* (Wall.) Spring, *S. polystachya* (Warb.) Hieron. to *S. permutata* Hieron., and both *S. ascendens* v.A.v.R. and *S. atroviridis* (Wall.) Spring to *S. intermedia* (B1.) Spring), and added 2 more species to the Malayan list *(S. stipulata* (B1.) Spring and *S. longiaristata* Hieron.). The last 2 species had been previously listed by him as varieties. The number of species accounted for by Alston therefore came to 26.

The present study recognises 28 species of which nine are considered to be probably endemic to the Malay Peninsula.

Habit and Morphology

In habit, species may be prostrate and creeping, such as *S. alutacia, S. strigosa* and *S. mayeri* (Plate 1), or suberect, e.g., *S. intermedia* (Plate 2) and *S. roxburghii,* ranging to scrambling, as in *S. willdenowii* (Plate 3). The stem, as in the last case, may continue for several meters, or, as with *S. morgani* and *S. stipulata,* be relatively short so that the plants are small.

The branching habit of the plant body is functionally dichotomous, so that references to 'pinnate branching' and 'fronds' may not be apt. The main 'stem' is a zigzag series of axes resulting from the alternate promotion of right and left branches of successive dichotomies. The term 'branch' will be used to refer to the weaker axis from each bifurcation along the 'stem' which will develop and ramify into a series of branchlets that ultimately bear the strobili. 'Branch-system' as used here includes the branch and the higher-order axes developing from it; to this, Alston (1934) had applied the term 'pinna'.

The branch-system is a series of dichotomies, also anisotomous in nature so that one of two main conditions may result (Fig. 1):

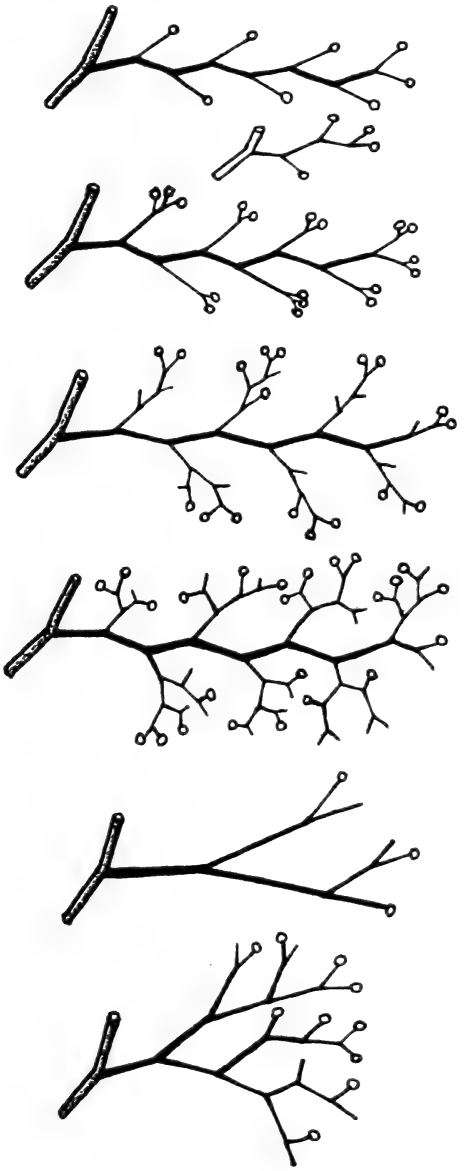
(a) A pseudopinnate array, in which an apparent main branch axis is recognizable, composed of a series of the more robust member from each dichotomy. Here, the less robust members of dichotomies will be in a distichous type of array, and may remain unforked *(S. wallichii)*, bear 1-2 unpronounced dichotomies at the tips *(S. stipulata)* or else they may be ostentatiously dichotomizing *(S. willdenowii, S. intermedia)*. Alston (1934) used the term 'pinnula', seemingly for each structure formed from the less robust members of dichotomies along the apparent main branch axis.

(b) A fan-shaped or flabellate array, in which no apparent unidirectional main branch axis is recognizable, composed of a series of obvious dichotomies (occasionally in *S. cuprea, S. intermedia, S. mayeri* and several others).

In each case the resulting appearance depends on the extent of dichotomy present. As can be expected, many species will exhibit more than merely one of the conditions from Fig. 1; in *S. wallichii* (Plate 5) and *S. stipulata,* however, a distinct appearance of the branch-system occurs consistently to afford rapid recognition. For these two species, the branch-system consists of the smaller axes in a distichous type of array and near enough for lateral leaves from adjacent branchlets to almost touch so that the entire branch-system appears lanceolate in outline. Other forms may occur consistently in select species, such as Type 3 of Fig. 1 for *S. frondosa* and *S. argentea* (Plate 4).

Whether or not branch-systems occur in the lower portion of the stem also contributes to the general appearance; in species such as *S. wallichii, S. caulescens, S. frondosa* and *S. argentea* the branch-systems are crowded at the upper part of the stem whereas in the creeping *S. mayeri* and the scrambling *S. willdenowii,* branch-systems arise at more regular intervals along the comparatively long stem (compare Plates 1, 3 & 5).

Roots commonly develop at the distal ends of rhizophores, which are positively geotropic, elongate organs possessing no root cap and often arising at points of bifurcation in the shoot. In suberect forms the development of rhizophores and roots is significantly pronounced towards the base of the stem while in creeping forms, rhizophores spring from throughout the shoot system and strike roots where they come into contact with the substrate. Occasionally, the emerging axis at a



1. Pseudopinnate; smaller axes simple.
(e.g., *S. wallichii,* and in condensed form in several creeping species)

2. Pseudopinnate; smaller axes forking at tips.
(e.g., *S. stipulata)*

3. Pseudopinnate; smaller axes dividing in pseudopinnate fashion.
(e.g., *S. willdenowii, S. argentea, S. frondosa*)

4. Pseudopinnate; smaller axes obviously dichotomized.
(e.g., *S. intermedia, S. caulescens, S. roxburghii)*

5. Flabellate, with few dichotomies.
(e.g., *S. intermedia, S. alutacia, S. mayeri)*

6. Flabellate, much dichotomized.
(e.g., *S. intermedia, S. cuprea, S. plana)*

Fig. 1 Branch-systems in *Selaginella.* Circles represent strobili.

point of bifurcation becomes transformed into a normal shoot instead of being the usual rhizophore.

The leaves are arranged in four rows along the branches and are anisophyllous so that a dorsi-ventral disposition results. The two rows of leaves in the upper plane are smaller and occupy a relatively median position, and are referred to as the median leaves. The two rows of leaves in the lower plane, larger and more lateral in position, are called lateral leaves. There is at each bifurcation in the branch-system also a leaf somewhat 'axillary' in position; this is termed the axillary leaf and is often better observed on the lower plane.

In form, the leaves take up various shapes (Fig. 2) and the margin may be entire to dentate or ciliate. The leaf surface may be glabrous or hairy to various degrees. I agree with Alston (1934) that the shape and margin of leaves present relatively constant character-states. In some species, the leaves near the base of the stem are of similar size so that the anisophylly so evident for the branch-system is obscured; in such cases the basal leaves may be spaced relatively further apart and range from erect and appressed to ascending in position. In others, the anisophylly of leaves is distinctly present throughout the plant's shoot system. Characteristic colours of the foliage may develop, such as the coppery tinge in *S. cuprea;* in *S. willdenowii,* the colour varies from green to bluish (Plate 3) while the usually dark green foliage of *S. intermedia* is occasionally purplish or coppery.

The leaves of *Selaginella* have been morphologically termed 'microphylls' (e.g., Foster & Gifford, 1974) to indicate their fundamental difference from the leaves ('megaphylls') of ferns and seed plants through the presence of a solitary unbranched vascular trace which is not associated with any leaf gap in the stele. However, there is no obligatory correspondence between leaf gaps and leaf traces in ferns such as *Gleichenia* and the Hymenophyllaceae (Boodle, 1901), and branched veins have been observed to be characteristic of *S. adunca* A. Br. ex Hieron. (Mukherjee & Sen, 1981). As such, although the term 'microphyll' may indicate anatomical differences from more complex 'megaphylls', it is not employed here and is more applicable in discussions on structural and evolutionary relationships between the two.

The strobili are terminal on branchlets and can take on two forms, as shown in Fig. 3. In the first, the sporophylls making up the strobilus are all subuniform so that a tetragonous structure results; where the distinct anisophylly of the leaves is continued into the reproductive structures, the second condition with bilaterally organized strobili occurs (Plates 7 & 8). All presently known Malayan species with bilateral strobili have the lower plane sporophylls smaller than those in the upper plane. Microspores are too tiny to be of taxonomic utility under merely 25× magnification, while megaspores have a distinctive triradiate ridge besides being larger and may have the wall reticulately patterned to slightly tuberculate. Both microsporangia and megasporangia occur mixed on the same strobilus although in many cases solely microsporangial strobili were observed. There seems to be no consistent pattern of distribution of megasporangia within the strobilus though quite frequently they occur on the lower plane in scattered manner and cause their

See opposite page

Plate 1. *Selaginella mayeri* creeping on a rock face. The stem is comparatively long, with branch-systems arising at quite regular intervals along its length.

Plate 2. *Selaginella intermedia* occurring as a patch of individuals with suberect habit. The branch-system can range from the flabellate condition with few dichotomies, as seen here, to the pseudopinnate condition.

Plate 3. *Selaginella willdenowii,* developing a long scrambling stem and a blue-green iridescence in the foliage.

Plate 4. *Selaginella argentea,* displaying branch-systems with a strikingly regular pseudopinnate condition.

Plate 1.

Plate 2.

Plate 4.

Plate 3.

Plate 5.

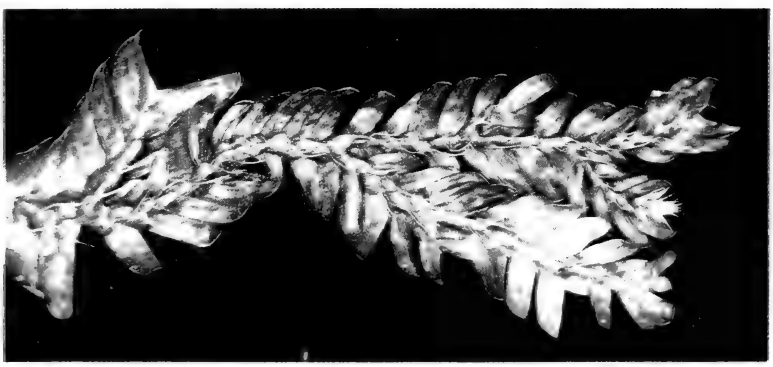


Plate 6.

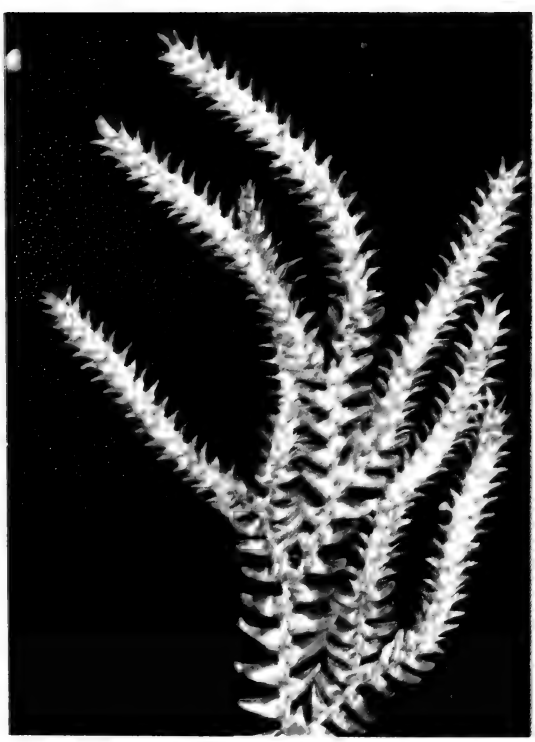
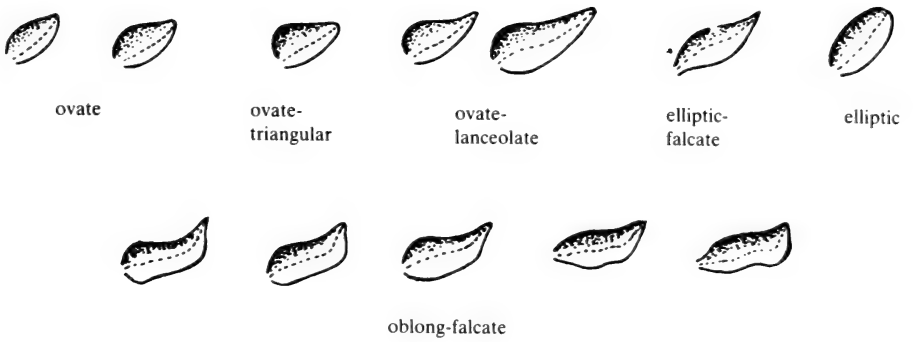


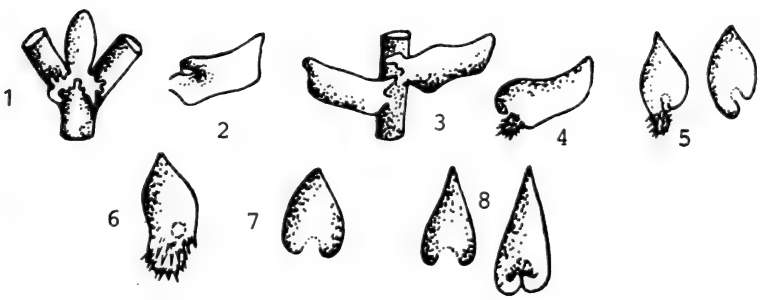
Plate 7.

Plate 8.



A. LATERAL LEAF SHAPES

B. MEDIAN LEAF APICES



C. ELABORATION OF LEAVES

1, auriculate axillary leaf; 2-4, elaboration of lateral leaves of the branch-system (2, with auriculate fold at base of upper margin; 3, with auricle at base of upper margin; 4, with subspinose-ciliate projection at base of lower margin); 5-8, elaboration of stem base leaves (5, with one side of the base prolonged into an auricle; 6, subpeltate; 7, cordate; 8, auriculate).

Fig. 2. Some characteristic features of the leaves in *Selaginella*.

See opposite page

Plate 5. ***Selaginella wallichii*** occurring as a patch of gregarious individuals. Note the distinct pseudopinnate branch-systems with unbranched smaller axes.

Plate 6. ***Selaginella intermedia*** var. *dolichocentrus*. Note the very long aristae of median leaves along the upper plane of branchlets.

Plate 7. Cone-bearing branchlets of *Selaginella ornata*. View of lower plane, showing the bilaterally symmetrical strobili (cones) with smaller lower plane sporophylls and larger upper plane sporophylls.

Plate 8. Cone-bearing branchlets of *Selaginella polita;* view of lower plane. See discussion on taxonomy for differences between this species and *S. ornata*.

subtending sporophylls to diverge at a greater angle from the strobilus axis (e.g., *S. roxburghii).* In what is termed a tetragonous strobilus, the megasporophylls are sometimes distinctly enlarged as in *S. willdenowii* despite the generally similar sizes of the sporophylls on both the lower and the upper planes.

Each sporophyll is often ovate with a pointed apex, with the concave inner surface cupped over the subtended sporangium; the sporophyll margin may be entire, dentate or ciliate, reflecting a similar condition for the leaves. In bilateral strobili, the larger upper plane sporophylls usually have a strong keel-like piece of tissue running down the inside surface of the sporophyll, along the middle.

Each sporophyll bears a short laminar structure, the ligule, near its base on the adaxial side. Pressed between the sporangium and its subtending sporophyll, the ligule may range from a translucent narrow bifid strip of tissue to a brownish scale-like structure; in any case it is very short, only about one-tenth the length of the sporophyll or less, often shrivelled and all too easily fractured in dried specimens.

Habitat Characteristics and Ecology

Most species occur in damp, shaded microhabitats. Many creeping species, such as *S. alutacia* and *S. mayeri,* are found spreading down moist earth-slopes or covering rocks in the forest or at stream-sides. Even on outcrops of quartzite or limestone, which are generally thought of as rather dry substrates, such species occur along crevices or at places sheltered by overhanging rocks, where the environment has better protection from drying out. As is known, there is no species confined to limestone in the Malay Peninsula.

In the forest, many suberect species are found as part of the herbaceous ground cover and occasionally they may be locally abundant so as to form rather homogenous patches, as with *S. intermedia* or *S. wallichii.* Earth-banks along trails and slopes in the forest are often decorated with the overlapping foliage sprays of suberect species like *S. roxburghii* and *S. stipulata.* There is no doubt that, like mosses and liverworts, where such species occur in dense cover, they contribute towards the checking of soil erosion along slopes.

S. willdenowii, by its rapid spread and clambering habit, is common along forest edges and soon becomes a smothering weed at many clearings and gaps. It can, however, grow lushly in darker conditions in the understorey of the forest, a situation in which its foliage commonly displays a metallic blue tinge (Plate 3). This iridescence is not due to pigmentation but rather a property of the leaf surface which probably behaves as an interference filter that gives peak reflectance at the blue part of the spectrum and increased transmission of light of higher wavelengths, notably those in the red region (Lee, 1977). This seems to be of adaptive advantage since light wavelengths in the red region predominate among photosynthetically active wavelengths in diffuse light reaching the rainforest floor (Sasaki et al, 1978). As in many shade tolerant plants, the iridescent leaves have more chlorophyll per unit protein than leaves exposed to the sun (Krishnan, 1975).

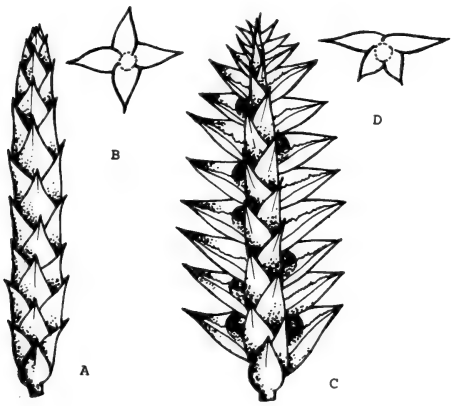


Fig. 3. Strobili in Peninsular Malaysian *Selaginella:* tetragonous type (*A, B*) and bilateral type (*C, D*). *A, C,* surface views; *B, D,* transverse sections.

Chromosomal counts have established basic numbers of x=9 *(S. ciliaris, S. intermedia, S. padangensis, S. willdenowii)* and x=10 *(S. delicatula, S. plana, S. wallichii)* for those Malayan species which have been counted (Jermy et al, 1967). The basic number x=9 was observed to correlate with a sporadic coning habit and an ability to continue branch growth throughout the life of the plant since only some of the growth apices are terminated by cone-formation, and x=10 to correlate with a simultaneous coning habit and finite growth of the branch-systems (Jermy et al, 1967). The act of coning simultaneously at the tips of all branchlets in a branch-system should perhaps not be construed as the factor causing finite growth of the branch-system, but rather as a habit accompanying an inherently determined finite growth; even in *S. wallichii* and *S. stipulata* which frequently bear cones at once on all branchlet tips of the whole aerial system, one comes across plants with a number of sterile branchlets while the remaining branchlets bear well-matured cones.

It has also been hypothesized (Jermy et al, 1967) that a sporadic coning habit, which allows prolonged ability to produce cones, is characteristic of species from more open habitats probably because the coning stimulus may be irregular and less often correlated with conditions conducive to successful propagation. In contrast, simultaneous coning may be an attribute of species in the relatively more stable environment of deep forest since this advantageously adapts the plant to respond to a coning stimulus concurrent with the onset of conditions favourable for effective propagation.

Species which may be said to have wide ecological amplitudes include *S. intermedia,* found from lowlands to montane forest and occuring in moist valleys and slopes as well as on drier hill ridges where the tall forest tree, *Shorea curtisii* (seraya), is dominant. *S. alutacia* is found also from the lowlands to montane forest but essentially occupies the shaded moist microhabitats therein; similarly *S. roxburghii* and *S. wallichii* are found from lowlands to upper dipterocarp forest. On the other hand are *S. morgani, S. ornata* and *S. polita* which occur at higher altitudes, mainly in montane oak or montane ericaceous forests.

Taxonomy

In the present account, 28 species including 3 varieties are recognized. The identities *S. permutata* sensu Alston and *S. stipulata* (Bl.) Spring listed by Alston (1937) are conspecific, having much variation in lateral leaf size and shape of axillary leaves; the earlier name *S. stipulata* is taken for this single species.

Three taxa have their original specific ranks reinstated. The first, *S. scabrida* Ridl. — recombined by Alston (1934) as *S. alutacia* var. *scabrida* (Ridl.) Alston — differs from *S. alutacia* Spring by its denticulate to dentate leaves as opposed to the ciliate leaves of *S. alutacia,* and by its hairy leaves and stems. While within *S. alutacia* the leaves can range from glabrous (usually) to short hairy on the upper surface, stem hairiness does not occur in any other Malayan species and appears to be distinctive. The sporophylls of *S. alutacia* are ciliate while in *S. scabrida* they are short-ciliolate. There is, therefore, some difficulty in considering these entities conspecific even though the leaves are similar in shape.

The second species to be reinstated is *S. curtisii* Ridl., formerly recombined by Alston (1934) as *S. alutacia* var. *curtisii* (Ridl.) Alston. *S. curtisii* has denticulate leaves and acuminate median leaves in comparison to the ciliate leaves and aristate median leaves of *S. alutacia.* An even more striking characteristic in *S. curtisii* is the tightly imbricate sporophylls of the strobilus, with the upper plane sporophylls held at a steeper position, at less than 45° from the strobilus axis; it is perhaps this compact condition of the strobilus that led Ridley (1919) to conclude that it is tetragonous instead of bilateral in symmetry. In *S. alutacia,* the sporophylls are less tightly imbricate with the upper plane sporophylls more spreading, at an angle of 45°-80° from the strobilus axis. Alston (1934) states that the condition of overlapping lateral leaves in his *S. alutacia* var. *curtisii* shows a complete transition to the condition typical of *S. alutacia* (non-overlapping lateral leaves); in this I agree but nonetheless, the other differences support a separate specific identity.

While dealing with specimens of *S. ornata* (Hk. & Gr.) Spring so determined and listed by Alston (1934), it became clear to me that his circumscription of the species contained two rather distinct elements, although in his treatment of the Javanese species (Alston, 1934b) he did comment that there was an enormous variation in leaf dimensions for *S. ornata.* The first element has oblong-falcate lateral leaves and a larger overall size with broader spread, and conformed to Ridley's description (1919) of *S. brachystachya* var. *ornata* (Hk. & Gr.) Baker (Alston did not give any description but reduced this to *S. ornata)* — this element is maintained here as *S. ornata* (Plate 7). The second element is comparable to the type of *S. polita* Ridl. (kindly confirmed by Dr. A.C. Jermy at the British Museum) which had been reduced to synonymy under *S. ornata* by Alston (1934); specimens representing this element have ovate to lanceolate lateral leaves (Plate 8) and smaller stature. Furthermore, this second element has bilateral strobili with the upper plane sporophylls only slightly longer than those of the lower plane, whereas in *S. ornata* as understood here, the upper plane sporophylls are as much as twice longer than the lower plane ones. *S. ornata* also has distinctly aristate median leaves while *S. polita* has acuminate to shortly aristate median leaves (the arista less than a fifth the length of the lamina). As such, *S. polita* is here reinstated.

Malayan species (being, as mentioned earlier, entirely within subgenus *Heterophyllum* Hieron.) may be naturally divided into two main groups. The first main group has tetragonous strobili and was called Section *Homostachyeae* by Ridley (1919); one has to bear in mind that under an earlier classification not adopted here, the group referred to presently would be considered as subgenus *Stachygynandrum* Baker, while under that same classification subgenus *Homostachys* Baker was employed to designate those (non-Malayan) species having dimorphous leaves and sporophylls, where the larger sporophylls are found on the lower plane. The second main group is characterised by bilateral strobili and was referred to as Section *Heterostachyeae* by Ridley (1919), equivalent to an earlier designation as subgenus *Heterostachys* Baker (which contained species with dimorphous leaves and sporophylls, and larger sporophylls on the upper plane).

Within the group with tetragonous strobili, smaller groups of related species may be discerned:

(i) *S. wallichii* (Hk. & Gr.) Spring and *S. stipulata* (Bl.) Spring, set off from all other species by their very distinct manner of branching;

(ii) a group with consistently entire leaves in which *S. padangensis* Hieron., *S. delicatula* (Desv.) Alston, *S. mayeri* Hieron. and *S. cuprea* Ridl. have exauriculate leaves, while *S. willdenowii* (Desv.) Baker and *S. plana* (Desv.) Hieron. have auriculate axillary leaves;

(iii) *S. caulescens* (Wall.) Spring, *S. frondosa* Warb. and *S. argentea* (Wall.) Spring with remarkably similar erect habit and appressed leaves at the stem base, the latter feature not seen in other species with non-entire leaves;

(iv) *S. strigosa* Bedd., *S. ridleyi* Baker, *S. rivalis* Ridl. and *S. longiaristata* Hieron., all with a creeping habit and ciliolate to ciliate leaves;

(v) *S. griffithii* Spring, *S. selangorensis* Bedd. ex Ridl., *S. repanda* (Desv.) Spring, *S. roxburghii* (Hk. & Gr.) Spring and *S. intermedia* (Bl.) Spring — suberect species with spreading lateral leaves at the stem base.

In the group with bilateral strobili, two smaller groups are easily distinguished:

(i) with creeping habit, in the lowlands mostly — in this group are *S. alutacia* Spring and *S. ciliaris* (Retz.) Spring (ciliate leaf margins) and *S. minutifolia* Spring, *S. curtisii* Ridl. and *S. scabrida* Ridl. (dentate leaf margins);

(ii) with suberect habit, at higher altitudes — in this group are *S. morgani* Zeiller, *S. ornata* (Hk. & Gr.) Spring and *S. polita* Ridl.

Nine species appear to be endemic to the Malay Peninsula: *S. cuprea, S. curtisii, S. morgani, S. polita, S. ridleyi, S. rivalis, S. scabrida, S. selangorensis* and *S. strigosa.*

The present account is based on sporophyte material. Finer structure, such as the surface ornamentation of leaves and spores as revealed by scanning electron microscopy, although not investigated here, is likely to provide supportive evidences towards understanding the relationships and differences between species. This avenue might also be explored in future investigations into variation within currently accepted species such as *S. alutacia* and *S. intermedia.*

An endeavour was made to keep features of the strobilus from dominating throughout the key, for frequent as strobili are in the field they may still be absent from specimens; this has likewise been the case for features of basal stem leaves, except where unavoidable. A combination of characters is employed where formerly a single character may be difficult to trace, such as the presence of a stoloniferous stem if only the aerial parts have been collected. Salient features of each species follow, together with a list of specimens examined. Thereunder, 'laterals', 'medians' and 'axillaries' refer to the corresponding leaves; branch-systems are abbreviated BS with reference to Fig. 1 The various herbaria mentioned are abbreviated thus: Forest Research Institute at Kepong (KLP), University of Malaya (KLU), Singapore (SING), Universiti Kebangsaan Malaysia (UKM) and Universiti Pertanian Malaysia (UPM).

Key to 28 Species of Peninsular Malaysian *Selaginella* (including 3 varieties)

1. Branch-systems exclusively pseudopinnate, the smaller axes very close together in distichous-type array, and not or slightly forking at the tips, the whole of each branch-system appearing lanceolate in outline,

2. Axillary leaves similar in size to lateral leaves, not overlapping onto branchlets; each branchlet of the distichous array rarely forking, and bearing a single strobilus ..... *S. wallichii*
2. Axillary leaves larger than lateral leaves, overlapping onto branchlets; each branchlet of the distichous array often forking 1-2 times bearing 2-3 strobili at the tips ..... *S. stipulata*

1. Branch-systems flabellate, if pseudopinnate then with much-branched smaller axes or else with branchlets well-spaced in between,

3. Habit prostrate, rooting at intervals,

4. Lateral leaves entire; axillary leaves along the main stem suborbicular ..... *S. mayeri*
4. Lateral leaves denticulate to ciliate; axillary leaves along the main stem ovate to elliptic,

5. Lateral leaves denticulate,

6. Stems glabrous; median leaves acuminate to shortly aristate,

7. Strobilus with upper-plane sporophylls held steeply at less than 45° from the axis ..... *S. curtisii*
7. Strobilus with upper-plane sporophylls held less steeply, at 45°-80° from the axis *S. minutifolia*

6. Stems hairy; median leaves distinctly aristate ..... *S. scabrida*

5. Lateral leaves ciliolate to ciliate,

8. Lateral leaves hairy to varying extents on upper side,

9. Strobili tetragonous; lateral leaves hairy on upper side to both sides ..... *S. strigosa*
9. Strobili bilateral; lateral leaves hairy on upper side only ..... *S. alutacia (p.p.)*

8. Lateral leaves glabrous,

10. Median leaves with arista exceeding lamina in length ..... *S. longiaristata*
10. Median leaves acuminate or with arista shorter than lamina,

11. Median leaves entire to denticulate; strobili bilateral ..... *S. ciliaris*

11. Median leaves ciliolate or ciliate; strobili either tetragonous or bilateral,

12. Lateral leaves elliptic; median leaves strongly ciliate ..... *S. ridleyi*
12. Lateral leaves ovate; median leaves ciliolate,

13. Strobili tetragonous ..... *S. rivalis*
13. Strobili bilateral ..... *S. alutacia (p.p.)*

3. Habit suberect to stiffly erect, rooting in the lower half,

14. Lateral leaves entire or subentire to denticulate,

15. All leaves entire,

16. Axillary leaves auriculate,

17. Plants when fully developed scrambling with stems reaching a meter long or more; lateral leaves with an auriculate fold at the basal part of the upper margin; colour often bluish-green ..... *S. willdenowii*
17. Plants not long scrambling; lateral leaves with an auricle at the basal part of the upper margin overlapping onto the branch; colour green ..... *S. plana*

16. Axillary leaves exauriculate,

18. Colour coppery; median leaves aristate; lateral leaves elliptic-falcate to oblong-falcate ..... *S. cuprea*
18. Colour green; median leaves acuminate to apiculate; lateral leaves oblong-falcate,

19. Plants reaching 60-80 cm tall; lateral leaves of main stem often more than 3 mm long; axillary leaves along main stem conspicuously large and orbicular, 3-4 mm across ..... *S. padangensis*
19. Plants smaller, to 40 cm tall; lateral leaves of main stem less than 3 mm long; axillary leaves along main stem obovate to suborbicular, to about 2 mm across ..... *S. delicatula*

15. Median leaves denticulate; lateral leaves subentire to denticulate,

20. Branches fine, often less than 1 mm across; plants with fine stoloniferous connections and below 25 cm tall; lateral leaves grey-green below,

21. Lateral leaves ovate to lanceolate ..... *S. selangorensis (p.p.)*
21. Lateral leaves oblong-falcate ..... *S. griffithii (p.p.)*

20. Branches stout, at least 1 mm across; plants without stoloniferous connections and mostly to over 25 cm tall; lateral leaves dark green below, at times coppery ..... *S. intermedia (p.p.)*

14. Lateral leaves dentate to ciliate,

22. Leaves at stem base erect-appressed, similar in size and distantly placed,

23. Lateral leaves of branch-system with a subspinose-ciliate projection at the basal part of the lower margin; leaves of stem base with one side of the base prolonged into a ciliate auricle and often subpeltate ..... *S. caulescens*
23. Lateral leaves of branch-system without any subspinose-ciliate projection at the base; leaves of stem base cordate to auriculate,

24. All leaves with a distinct pale margin; upper margin of lateral leaves exauriculate; axillary leaves of main branch axes cordate to subauriculate ..... *S. argentea*
24. Leaves without a distinct pale margin; upper margin of older lateral leaves auriculate; axillary leaves of main branch axes auriculate ..... *S. frondosa*

22. Lateral leaves at stem base spreading and close together, distinctly larger than the median leaves,

25. Lateral leaves ciliolate to ciliate at base,

26. Median leaves acuminate ..... *S. repanda*
26. Median leaves aristate,

27. Lateral leaves dentate to ciliolate ..... *S. intermedia* var. *dolichocentrus (p.p.)*
27. Lateral leaves basally ciliate,

28. Plants often about 12 cm tall or more, without stoloniferous connections; main stems at least 1 mm across,

29. Lateral leaves glabrous ..... *S. roxburghii*
29. Lateral leaves with upper surface short-hairy ..... *S. roxburghii* var. *strigosa*

28. Plants often less than 12 cm tall, with fine stoloniferous connections; main stems fine, less than 1 mm across ..... *S. selangorensis var. ciliata*

25. Lateral leaves denticulate to dentate,

30. Lateral leaves ovate to lanceolate,

31. Strobili bilateral; median leaves acuminate to shortly aristate (arista less than ⅕ lamina length),

32. Plants often in closely clumped turfs; lateral leaves ovate-triangular, 1-2 mm long .... *S. morgani*

32. Plants growing in well-spaced patches; lateral leaves ovate-lanceolate, often 3 mm long ..... *S. polita*

31. Strobili tetragonous; median leaves distinctly aristate (arista ¼ to over ½ the lamina length) ..... *S. selangorensis (p.p.)*

30. Lateral leaves oblong-falcate,

33. Strobili bilateral ..... *S. ornata*
33. Strobili tetragonous,

34. Median leaves with arista distinctly exceeding lamina in length ..... *S. intermedia* var. *dolichocentrus (p.p.)*
34. Median leaves with arista not exceeding lamina in length,

35. Branches fine, not more than 1 mm across; plants with fine stoloniferous connections and often below 25 cm tall; lateral leaves grey-green below ..... *S. griffithii (p.p.)*
35. Branches stouter, at least 1 mm across; plants without stoloniferous connections and mostly to over 25 cm tall; lateral leaves dark green below, at times coppery ..... *S. intermedia (p.p.)*

1. S. alutacia Spring, Bull. Ac. Brux. 10 (1843) 233, no. 154.
S. oligostachya Baker, Ann. Bot. 8 (1894) 132, no. 272.
S. montana Ridley, J.R. As. Soc. Str. Br. 80 (1919) 159, no. 33.

Creeping; BS 1,5, short; stem laterals close together, spreading; BS laterals ovate-triangular, ciliate with basally distended upper margin, exauriculate, glabrous to variously hairy on upper side; axillaries ovate, exauriculate, overlapping branches slightly; medians ciliate with arista often ½ to ⅔ lamina length; strobilus bilateral.

Specimens examined:

Johore: Gunong Pulai, *Ridley 12137* (SING); Gunong Panti, 1600 ft. alt., *Holttum SFN 18076* (SING).

Negri Sembilan: Gunong Angsi, *Ridley 11873* (SING), 2500 ft. alt., *Nur SFN 11562* (SING).

Malacca: Mt. Ophir, *Ridley 9889* (SING); *Ridley 3347* (SING, ISOTYPE of *S. oligostachya* Baker).

Selangor: Templer Park, *Shimizu et al M13766* (SING); Bt. Kanching For. Res., *Nur* s.n. 2.11.1937 (SING); Ulu Langat, *D. W. Lee Ul-4* (KLU); Semenyih, *Hume 7906* (SING); Bt. Enggang For. Res., Kajang, *Symington FMS 24113* (KEP); Gua Batu, *Ridley 8150* (SING); Ulu Sg. Gombak, *Shimizu et al M14003* (SING); Gombak, 20th mile, *K.M. Salleh KMS 245* (UKM); Bt. Kutu, *Ridley 7824* (SING), 3000 ft. alt., *Ridley 7829* (SING); Genting Simpah, *Hume 8497*

(SING), *9743* (SING), c. 1500 ft. alt., *Hume 8834* (SING), *9014* (SING), *9380* (SING), *9531* (SING).

Pahang: Way from K. Lumpur to Gunong Ulu Kali, c. 1200 m alt., *Shimizu et al M14065* (SING); Gunong Tahan, *Ridley 15959* (SING), Wray's Camp, *Ridley 16200* (SING, isotype of *S. montana* Ridley); P. Tioman, summit of Gunong Kajang, 3200-3400 ft. alt., *D.W. Lee KLU 19797* (KLU), below summit of Gunong Kajang, 3000 ft. alt., *D.W. Lee KLU 19730* (KLU).

Perak: Temango, *Ridley 14464* (SING), *14471* (SING), *14473* (SING); Gunong Kledang, *Ridley 9576* SING), *9577* (SING); Kledang Saiong, *Symington FMS 25791* (KEP); Bujong Malacca, *Ridley 9578* (SING), *Curtis 3308* (SING); Lumut, *Ridley 10349)* (SING), Dindings, *Curtis* s.n. Dec. 1902 (SING); Tapah, *Ridley 14024* (SING); Taiping Waterfall, *Ridley 14462* (SING); Taiping Hills, *Ridley 11425* (SING); Bt. Kepayong, Sg. Siput, *Ridley 11870* (SING).

Symington FMS 25791 from Perak has exceptionally hairy leaves. The varieties *S. alutacia* var. *curtisii* and *S. alutacia* var. *scabrida* of Alston (1934) are transferred back to their original specific identities (see text). For *S. alutacia* var. *pensile* (Ridl.) Alston, see end of listing.

Alston (1934) listed this species as possibly endemic but subsequently documented this for Java (Alston, 1934b) and Sumatra (Alston, 1937).

2. S. argentea (Wall.) Spring, Bull. Ac. Brux. 10 (1843) 137, no. 14.
Lycopodium argenteum Wall., Cat. (1829) no. 127; Hk. & Gr. in Hk. Bot. Misc. 2 (1831) 384. Plate 4

Stiffly erect; BS 3,4; stem base laterals distant from one another, appressed-erect, of similar size to medians, cordate-subauriculate with ciliate bases; BS laterals ovate-lanceolate to oblong-falcate, ciliolate to ciliate with basally distended upper margin, exauriculate; axillaries ovate, subcordate to subauriculate, overlapping branches slightly; medians dentate with arista often ⅓ to ½ lamina length; all leaves with distinct pale margin; strobilus tetragonous.

Specimens examined:

Pahang: Tanjong Antan, *Ridley 2166* (SING).

Kedah: Telaga Tujoh, *Ridley 15673* (SING).

Penang: Penang Hill, *Ridley 7035* (SING), *7083* (SING); Government Hill, *Ridley 5173* (SING); Waterfall, *Curtis 3059* (SING); Waterfall Gardens, *Wong FRI 32384* (KEP).

Sine loc., *Cantley 129* (SING).

3. S. caulescens (Wall.) Spring, Bull. Ac. Brux. 10 (1843) 137, no. 12.
Lycopodium caulescens Wall., Cat. (1829), no. 137; Hk. & Gr. in Hk. Bot. Misc. 2 (1831) 382.
S. peltata Presl, Abh. Bohm. Ges Wiss., ser. 5, 3 (1844) 582; Alston, Bull. Jard. Bot. Buit., ser. 3, 13 (1934) 441.

Stiffly erect; BS 3,4; stem base laterals distant from one another, appressed-erect, of similar size to medians, with one side of the base prolonged into a ciliate auricle and often subpeltate; BS laterals ovate-lanceolate to oblong-falcate, ciliolate to ciliate with basally distended upper margin, with a subspinose ciliate projection at the basal part of the lower margin, otherwise exauriculate; axillaries ovate, subcordate, overlapping branches slightly; medians

acuminate to shortly aristate, denticulate, with a ciliate outer auricle, often subpeltate; strobilus tetragonous.

Specimens examined:

Perak: Jor, *Haniff SFN 14214* (SING), 1800 ft. alt., *Henderson FMS 10825* (SING).

Penang: Botanic Gardens, cultivated, *Curtis* s.n. (SING).

4. S. ciliaris (Retz.) Spring, Bull. Ac. Brux. 10 (1843) 231, no. 136.
Lycopodium ciliare Retz., Obs. 5 (1789) 32, no. 92.

Creeping; BS 1,5, short; stem laterals close together, spreading; BS laterals ovate-lanceolate to oblong-falcate, ciliate with basally distended upper margin, exauriculate; axillaries ovate, slightly cordate, overlapping branches; medians denticulate-subentire, acuminate; strobilus bilateral.

There are no Peninsula specimens available locally but the identity is clear from both Alston's key (1934) and non-Peninsula specimens at SING:

Borneo — stream below Dallas, *Holttum SFN 25370* (SING).

Papua — Kanosia, *Carr 11754* (SING).

This is certainly close to *S. alutacia* from which it differs by the nature of the medians.

5. S. cuprea Ridley, J. R. As. Soc. Str. Br. 80 (1919) 152, no. 14, excl. var. *major*.

Suberect; BS 4,6; stem base laterals close together, ascending to spreading, larger than medians; BS laterals elliptic-falcate to ovate-lanceolate, coppery in colour, entire, upper margin not or only slightly basally distended, exauriculate; axillaries ovate, overlapping branches slightly; medians entire with arista often ⅔ as long as lamina; strobilus tetragonous.

Specimens examined:

Selangor: Ulu Langat, near Dusun Tua, *D.W. Lee UL-55* (KLU); Sg. Batu, *Poore 220* (KLU).

Pahang: Sg. Tahan, *Md. Shah MS 1412* (KEP); Tahan, Wray's Camp, *Ridley 16198* (SING, syntype).

Perak: Bujong Malacca, *Ridley 9574* (SING, syntype).

Trengganu: Kemaman, Sg. Sisir, *Corner SFN 32262* (SING).

Kelantan: K. Pertang, *Haniff & Nur SFN 10377* (SING).

This appears endemic to the Peninsula.

6. S. curtisii Ridley, J.R. As. Soc. Str. Br. 80 (1919) 148, no. 2.
S. alutacia var. *curtisii* (Ridl.) Alston, Gard. Bull. S.S. 8 (1934) 56, **syn. nov.**

Creeping; BS 1,5, short; stem laterals close together, spreading; BS laterals ovate-triangular, denticulate-dentate with basally distended upper margin, exauriculate, glabrous; axillaries ovate, exauriculate, overlapping branches slightly; medians denticulate-dentate, acuminate; strobilus bilateral with the upper-plane sporophylls held steeply towards the strobilus axis, all sporophylls tightly imbricate.

Specimen examined:

Perak: Bujong Malacca, *Curtis 3378* (SING, holotype).

This is evidently very rare; no other specimens of this were encountered and both Ridley (1919) and Alston (1934) also cite the above single specimen.

7. S. delicatula (Desv.) Alston, J. Bot. 70 (1932) 282.
Lycopodium delicatulum Desv. ex Poir., Encycl. Suppl. 3 (1814) 554, no. 99.

Suberect, to about 40 cm tall; BS 3,4; stem base laterals distant, ascending, of similar size to medians; BS laterals oblong-falcate, entire, exauriculate and often pale green; axillaries elliptic-obovate, often broadly ovate to suborbicular on main stem, to about 2 mm across, exauriculate, not overlapping branches; medians entire, pointed to apiculate; strobilus tetragonous.

Specimens examined:

Selangor: Batu Caves, *D.W. Lee KLU 20822* (KLU).

Pahang: Bt. Chintamani limestone between Bentong and Karak, *Chin 449* (KLU).

Kedah: Kg. Naka, *Holttum SFN 19834* (SING); Langkawi, Pasir Hitam, *Hamzah B99* (KLU), Gunong Raya, *Haniff & Nur SFN 7156* (SING), North base of Gunong Raya, on granite, *Stone 14305* (KLU), between Ayer Hangat and Tanjong Ru on limestone, *Chin 504* (KLU), Telok Panchor Air on limestone slope, *Chin & Chia 2127* (KLU), Selat Panchor, on limestone rocks, *Henderson SFN 29190* (SING); Bt. Wang, *Haniff SFN 1202* (SING).

Penang: Chitty Temple, stone quarry, Curtis 3380 (SING).

Perlis: near Kangar, *Ridley* s.n. March 1910 (SING); Mata Air For. Res., *Wong FRI 32121* (KEP).

8. S. frondosa Warb., Monsunia 1 (1900) 105.

Stiffly erect, with stout stoloniferous connections, to about 25 cm tall; BS 3,4; stem laterals distant, erect-appressed, of similar size to medians, with ciliate usually incurved auricles; BS laterals oblong-falcate, ciliolate, older ones with base of upper margin auriculate; axillaries ovate, auriculate, overlapping branches slightly; medians denticulate, acuminate to shortly aristate; strobilus tetragonous.

Specimens examined:

Johore: Ulu Kahang c. 400 ft. alt., *Holttum SFN 10928* (SING).

Selangor: Ulu Langat, near Dusun Tua, *D.W. Lee UL-56* (KLU); Templer Park, *Wong FRI 32233* (KEP).

Pahang: Base of Kota Glanggi, *Henderson SFN 22496* (SING); West of Joara Bay, *Burkill SFN 1138* (SING); bank of Sg. Endau, *Betty & Latiff KLU 18557 (KLU); Taman Negara, Ugul KLU 21966* (KLU), K. Trenggan, *Stone & Wong KLU 13887* (KLU); Lesong For. Res., *Wong FRI 32389* (KEP); Krau Game Res. at Sg. Lompat, *Ruth Kiew RK 1046* (UPM).

Perak: Kamuning, *Curtis 3309* (SING); Tapah, *Wray 1761* (SING); Ulu Selama, *Wray 4156* (SING).

Kelantan: Gua Musang, Sg. Galas, *Henderson SFN 22602* (SING).

9. S. griffithii Spring, Bull, Ac. Brux. 10 (1843) 145, no. 80.

Suberect, with fine stoloniferous connections, often below 25 cm tall; BS 3,4 short; stem base laterals close together, spreading, larger than medians; BS

laterals oblong-falcate, grey-green below, denticulate to subentire with slightly distended upper margin, exauriculate; axillaries ovate, exauriculate, overlapping branches slightly; medians denticulate with arista to more than half the lamina length; strobilus tetragonous.

Specimens examined:

Kedah: Langkawi, *Curtis* s.n. Sept. 1890 (SING), *Holttum SFN 17415* (SING), Gunong Raya, *Haniff & Nur SFN 7191* (SING).

Besides the different leaf shape, this is larger in stature than *S. selangorensis,* which in other aspects it resembles. This, however, has been collected in Malaya only from Langkawi, and also occurs in Thailand.

10. S. intermedia (Bl.) Spring, Bull. Ac. Brux. 10 (1843) 144, no. 66.
Lycopodium intermedium Bl., Enum. Pl. Jav. 2 (1830) 269, no. 20.
L. atro-viride Wall., Cat. (1829) no. 120; Hk. & Gr. in Hk. Bot. Misc. 2 (1831) 387.
S. atroviridis (Wall.) Spring, Flora 21 (1838) 183; Alston, Gard. Bull. S.S. 8 (1934) 53, excl. var. *ciliata.*
S. ascendens v.A.v.R., Bull. Jard. Bot. Buit., ser. 2, 11 (1913) 33; Alston, Gard. Bull. S.S. 8 (1934) 52, Bull. Jard. Bot. Buit., ser. 3, 14 (1937) 179.
S. cuprea var. *major* Ridl., J. R. As. Soc. Str. Br. 80 (1919) 152.
S. plumea Spring in Ridl., J. R. As. Soc. Str. Br. 80 (1919) 151. Plate 2

S. intermedia var. **intermedia**

Suberect, to 25-30 cm tall or more; BS 4,5,6; stem base laterals close together, spreading, larger than medians; BS laterals oblong-falcate, dentate to subentire (subdenticulate) often with basally distended upper margin, exauriculate, in nearly all cases glabrous; axillaries ovate, exauriculate, overlapping branches slightly; medians dentate, acuminate or (more often) with arista up to ¾ lamina length, sometimes hairy on upper side; strobilus tetragonous.

Specimens examined:

Johore: Gunong Pulai, summit, *Nur & Kiah SFN 7797* (SING), 300-650 m alt., *Iwatsuki, Fukuoka & Hutoh M 14172* (SING); Batu Pahat, *Ridley 11220* (SING); Kota Tinggi waterfall, *Md. Shah MS 445* (SING); Sg. Pelepah Kiri, *Corner SFN 33571* (SING), *33572* (SING).

Negri Sembilan: Gunong Angsi For. Res., *Osman FMS 23785* (KEP).

Selangor: Genting Simpah, *Hume 9603* (SING), *Nur SFN 34283* (SING); 15th mile Pahang Track, *Ridley 8770* (SING)*; Ulu Gombak, ridge top, *Strugnell FMS 27896* (KEP), For. Res. near Genting Simpah, 2500 ft. alt., *Wyatt-Smith KEP 79195* (KEP); Ulu Sg. Gombak, *Shimizu et al M 14006* (SING); Kajang, Sg. Lalang For. Res., *Symington FMS 22793* (KEP); Bt. Tunggul For. Res., *Jabil KEP 77661* (KEP); Ulu Langat, *D.W. Lee KLU 21965* (KLU), on summit ridge of Gunong Hitam near Kg. Ulu Lui, *D.W. Lee & Mahmud UL-29* (KLU); Gunong Nuang, false summit, 4800 ft. alt., *D.W. Lee UL-91* (KLU), summit ridge, *D.W. Lee* s.n. 15.8.1974 (KLU); University of Malaya campus, *Ugul KLU 21958* (KLU), Rimba Ilmu, *Low 79* (KLU); Bt. Lagong For. Res., 1500 ft. alt., *Abd. Samat b. Abdullah 145* (KLU).

Pahang: Jengka For. Res., *Evans 219* (KLU), half mile South of Sg. Kerut, *(Turnau 892* (KLU); P. Tioman, summit of Gunong Kajang, 3400 ft. alt., *D.W. Lee KLU 19732* (KLU); Gunong Tahan, 3300 ft. alt., *Wray & Robinson 5366* (SING), c. 5500 ft. alt., Seimund 194 (SING), Wray's Camp, *Ridley 16197* (SING); Sg. Tahan, *Kiah SFN 31723* (SING); Bt. Belar, Ulu Sg. Tembeling, *Md. Shah 1638* (KEP); Telom, *Ridley 13989* (SING); Fraser's Hill, *Kalong FMS*

22416 (SING), 4000-4370 ft. alt., *Burkill & Holttum 8453* (SING); Cameron Highlands, Robinson Falls, *Henderson SFN 11725* (SING); Southwest of Jerantut For. Res., *Wyatt-Smith KEP 93383* (KEP); Kota Glanggi, *Henderson SFN 22509* (KEP); Genting Highlands, 4000 ft. alt., *Noraini 32* (UKM).

Perak: Batu Salil, Gunong Korbu, *Strugnell & Tachun FMS 45857* (KEP); Dindings, Segari Melintang For. Res., *Strugnell FMS 16569* (KEP)*; Gunong Hijau, 4700 ft. alt., *Burkill SFN 12896* (SING); Gunong Kledang,, *Ridley 9571* (SING), Kledang Range, *Curtis 3310* (SING).

Kedah: Kedah Peak, *Ridley 5175* (SING), c. 3000 ft. alt., *Holttum SFN 15024* (SING), 3100 ft. alt., *Burkill 3315* (SING), 3400 ft. alt., *Lo & Mahmud 48* (KLU)*; P. Rumba, *Seimund* s.n. 12.3.1926 (SING); Langkawi, Gunong Raya, *Corner* s.n. 15.11.1941 (SING)*; Baling, *Md. Noor FMS 21627* (KEP).

Specimens marked with an asterisk conform to the features for *S. ascendens* (Alston, 1934), i.e., with 'lateral branches 1-2-forked.' However, many specimens have branching intermediate between this type and more extensively branched forms typical of *S. intermedia* and it is not uncommon to find both simpler and more complex branch-systems on one specimen.

Juvenile forms are obviously less branched and smaller, and root freely; I agree with Alston (1934) that the apparently creeping specimen, *Ridley 9990,* from Mt. Ophir (SING) is in a juvenile (also sterile) state.

Occasionally, the upper surfaces of medians are shortly hairy; very rarely the upper surfaces of both medians and laterals are hairy *(D.W. Lee* s.n. 15.8.1974 from Selangor, and *Noraini 32* from Pahang) — perhaps this may be a distinct variety.

There is also a smaller-leafed form of this species, with the lateral leaves less than 4 mm long, and coppery in colour. This has been called *S. cuprea* var. *major* by Ridley (1919) but is not admissible to that species because of dentate margins of the lateral leaves; it is appropriately noted by Alston (1934) as a small form of *S. atroviridis* (a synonym of *S. intermedia).* It is well to note that in *S. intermedia,* leaf size is a very variable character and colouration can vary from dark green to coppery or purplish hues. The following specimens conform to this smaller-leafed form:

Selangor: Genting Simpah, *Hume 8837* (SING); Bt. Hitam, *Ridley 7817* (SING).

Pahang: Gunong Tahan, Sg. Reriang, 3000-3500 ft. alt., *Holttum SFN 20597* (SING), Wray's Camp, *Ridley 16199* (SING); Bt. Chemaga, Chigar Perah, *Henderson SFN 19490A* (SING).

Perak: Taiping Waterfall, *Ridley 14460* (SING, SYNTYPE of *S. cuprea* var. *major* Ridl.); Temengoh, *Ridley 14468* (SING); Tapah, *Curtis 3112* (SING); Dindings, Lumut, *Curtis* s.n. Dec. 1902 (SING); Kledang Saiong, *Symington FMS 25870* (KEP); Gunong Bubu For. Res., *Hou 617* (KEP), 637 (KEP).

Kelantan: Ulu Mering, Sg. Brok, *Ng FRI 5467* (KEP).

S. intermedia var. **dolichocentrus** K.M. Wong, **var. nov.**

Plate 6

Caules suberectus in dimidio inferiore radicantes; foliis lateralibus falcato-oblonga margine dentatus vel ciliolatus; paginae infra plerumque griseo-viridis; foliis mediis aristis laminae longiores; sporophylla uniformes, strobili tetragoni.

Stems suberect, rooting in the lower half; lateral leaves oblong-falcate with

dentate or ciliolate margin, surfaces below often grey-green; median leaves with arista exceeding lamina in length; sporophylls uniforms, strobili tetragonous.

TYPE: Ridley 13993 from Pahang, Telom (SING, **holotype**).

Specimens examined:

Johore: Mt. Ophir via Tangkak, 3000-4000 ft. alt., *Md. Shah & Samsuri MS 3598* (KEP, KLU).

Selangor: Semangkok Pass, *Ridley* s.n. 1904 (SING), *12038* (SING).

Pahang: Telom, *Ridley 13993* (SING); Gunong Berumbun, *Ridley 13992* (SING); Cameron Highlands, *Jaamat FMS 25180* (KEP), near Tanah Rata, *Henderson SFN 17721* (SING), *en route* from Tanah Rata to Habu area via Robinson falls, *Iwatsuki, Fukuoka & Hutoh M 13647* (SING); Bt. Fraser, 4000 ft. alt., *Smith 848* (SING), 3900 ft. alt., *Wong FRI 32033* (KEP).

Perak: Taiping, *Hervey 1667* (SING); Gunong Hijau, *Anderson 21* (SING); Gunong Bal, 4500 ft. alt., *Haniff SFN 14745* (SING); Maxwell's Hill, *Abd. Samat b. Abdullah 371* (KLU).

Penang: Government Hill, *Fox 10662* (SING).

This is the same as Alston's *S. atroviridis* var. (b), vide Alston (1934), which he subsequently suggested may be better placed under *S. roxburghii* (Alston, 1937). While this bears superficial resemblance to *S. roxburghii* in its grey-green colour on the lower side of the lateral leaves, as well as in the rather distended base of the upper margin of the lateral leaves, it is near to *S. intermedia* with its larger stature and ciliolate to dentate leaf margins. The occurrence of a markedly long median leaf arista can be accommodated within *S. intermedia* where the apex of the median leaf can vary from being acuminate to aristate. The grey-green colouration of the lower leaf surfaces and a distended base of the upper margin of lateral leaves occasionally occur in *S. intermedia* which, as Alston (1934) noted, is a very variable species.

The very long aristae of the median leaves (Plate 6) allow this variety to be easily distinguished from *S. intermedia* var. *intermedia*.

11. S. longiaristata Hieron., Hedwigia 50 (1910) 16.
S. atroviridis var. *ciliata* Spring in Alston, Gard. Bull. S.S. 8 (1934) 53; Bull. Jard. Bot. Buit., ser. 3, 14 (1937) 175.

Creeping; BS 3,4,5, short; stem laterals close together, spreading; BS laterals ovate, ciliolate, exauriculate; axillaries ovate, exauriculate, overlapping branches slightly; medians ciliolate with arista exceeding lamina in length; strobilus tetragonous.

There are no peninsular specimens available locally but the identity is clear from both Alston's key (1937) and a specimen from Sumbawa (*Colfs 13*, at SING) so determined by Alston in 1935. Alston (1934) cited only one specimen (from Malacca, collected by Griffith); this species would seem to be rather rare.

12. S. mayeri Hieron., Engl. & Prantl, Nat. Pfl. 1, 4 (1901) 700, no. 343.

Plate 1

Creeping; BS 1, 5, short; stem laterals close together, spreading; BS laterals oblong-falcate to slightly elliptic, entire or subentire with upper margin not or

only slightly basally distended, exauriculate; axillaries obovate, orbicular on main stem, exauriculate, overlapping branches; medians entire, acuminate to apiculate; strobilus tetragonous.

Specimens examined:

Negri Sembilan: Jeram Toi, 250 m alt., *Amran AMF 6* (UKM), *Rashid NAR 3 (UKM)*.

Selangor: Kepong, Abd. Samat b. Abdullah s.n. 18.11.1961 (KLU), Forest Research Institute grounds, *Wong FRI 32016* (KEP), path to Bt. Lagong, *Wong FRI 32019* (KEP).

Pahang: Taman Negara, *Ugul KLU 21961* (KLU), Sg. Teku, *Kiah* s.n. 23.7.1936 (SING), Tembeling, *Holttum SFN 24728* (SING), Gua Tipus, *Henderson SFN 22552* (SING), Gunong Senyum, *Henderson SFN 22230* (SING), *Henderson SFN 22322* (SING); Fraser's Hill, 1350 m alt., *K.M. Salleh KMS 250* (UKM).

Perak: Between 19th & 20th mile Tapah — Tanah Rata road, *Turnau 1139* (KLU); Tanjong Malim, *Ridley 11857* (SING).

Penang: Chitty Temple, stone quarry, *Curtis* s.n. Aug. 1896 (SING); waterfall, *Curtis 1734* (SING).

Kelantan: Gua Musang, *Boey 315* (KLU), limestone outcrop, *Chin 86* (KLU), *Chin 1419* (KLU); Gua Tapah limestone hill, *Chin 1608* (KLU); Sg. Keteh, Batu Papan, *Nur SFN 12081* (SING).

13. S. minutifolia Spring, Mem. Ac. Belg. 24 (1850) 239, no. 176.

Creeping; BS 1,4,5, short; stem laterals close together, spreading; BS laterals ovate to triangular, denticulate with basally distended upper margin, exauriculate; axillaries ovate, exauriculate, overlapping branches slightly; medians denticulate to ciliolate, acuminate to shortly aristate; strobilus bilateral.

Specimens examined:

Selangor: Bt. Kutu, anon., May 1891 (SING); Ulu Langat, Gunong Hitam, 3970 ft. alt., *D.W. Lee & Mahmud UL-34* (KLU); Templer Park, near base of Bt. Takun, *Abd. Samat. b. Abdullah 592* (KLU); Bt. Anak Takun, *Chin 15* (KLU).

Pahang: Fraser's Hill, 1350 m alt., *Md. Sarif MSAM 7* (UKM).

Kedah: anon., *SFN 37860* (SING); Langkawi, Telaga Tujoh, *Razali RJ 661* (UKM).

14. S. morgani Zeiller, Bull. Soc. Bot. Fr. 32 (1885) 78.

Suberect; BS 1,5, short; stem base laterals close together, spreading, larger than medians; BS laterals ovate with blunt apex, dentate with upper margin slightly to well distended basally, exauriculate; axillaries ovate, exauriculate, overlapping branches; medians dentate, acuminate; strobilus bilateral.

Specimens examined:

Pahang: Cameron Highlands, below forest station, *Poore 160* (KLU), *Turnau 943* (KLU), ridge, 6000 ft. alt., *Wyatt-Smith* s.n. (KEP), Break Pressure Tank Hill, *Burkill 842* (SING), Brinchang Village, *Poore 98* (KLU), Gunong Brinchang, 6600 ft. alt., *University of Malaya 8061* (KLU), near Tanah Rata, *Turnau 1266* (KLU); Gunong Siku, *Jaamat FMS 27658* (KEP); Gunong Berumbun, upper part, *Poore 580* (KLU).

Perak: Gunong Raya, 5700 ft. alt., *Strugnell & Tachun FMS 45875* (KEP).

15. S. ornata (Hk. & Gr.) Spring, Bull. Ac. Brux. 10 (1843) 232, no. 145.
Lycopodium ornatum Hk. & Gr. in Hk. Bot. Misc. 3 (1833) 108.
S. ornata sensu Alston, *p.p.*, Gard. Bull. S.S. 8 (1934) 57-58. Plate 7

Suberect; BS 4,5,6, stem base laterals close together, spreading, larger than medians; BS laterals oblong-falcate, denticulate to dentate with basally distended upper margin, exauriculate; axillaries ovate-subcordate, exauriculate, overlapping branches; medians denticulate to dentate, with arista often more than half the lamina length; strobilus bilateral.

Specimens examined:

Negri Sembilan: Jeram Toi, 250 m alt., *Rashid NAR 4* (UKM).

Selangor: Semangkok Pass, *Ridley 12039* (SING); Gunong Nuang, summit, *D.W. Lee* s.n. 15.8.1974 (KLU).

Pahang: Fraser's Hill, *Nur SFN 11020* (SING), *Corner* s.n. 13.8.1937 (SING), on trail to Pine Tree Hill, *Burkill 2339* (SING), 4400 ft. alt., *D.W. Lee KLU 19735* (KLU), 1350 m alt., *K.M. Salleh KMS 274* (UKM), *Rashid NAR 10* (UKM); Cameron Highlands, near forest station, *Poore 157* (KLU); Gunong Tahan, *Haniff & Nur SFN 7974* (SING); Gunong Bunga Buah, 3600 ft. alt., *Zaleha Yunos UKM 2092* (UKM).

Perak: Birch's Hill, *Wray* s.n. (SING); Maxwell's Hill, *Ridley 5181* (SING); Gunong Hijau, *Sinclair & Kiah SFN 38676* (SING).

Penang: Penang Hill, 2000 ft. alt., *Holttum SFN 31198* (SING).

It appears that Alston's concept of *S. ornata* (Alston, 1934) contained two distinct groups (see text) of which one is maintained as *S. ornata* here while the other has been determined as *S. polita* Ridley.

16. S. padangensis Hieron., Hedwigia 50 (1910) 34.

Suberect, with a broad spread, reaching 60-80 cm tall; BS 3,4; stem base laterals distant, ascending to spreading, of similar size to medians; BS laterals oblong-falcate, entire, slightly to (often) not auriculate; axillaries along main stem conspicuously large and orbicular, 3-4 mm across, exauriculate, not overlapping branches; medians entire, acuminate to apiculate; strobilus tetragonous.

Specimens examined:

Selangor: Genting Simpah, *Hume 9386* (SING); Bt. Takun, base, *Wong FRI 32049* (KEP, KLU); Batu Caves, inside dark cave, *Ugul & Bala KLU 21964* (KLU); Kepong, Forest Research Institute, path to waterfall, *Wong FRI 32012* (KEP, KLU); Gombak, University of Malaya Field Studies Centre, *Willis* s.n. 1.4.1974 (UKM).

Pahang: Tembeling, *Holttum SFN 24696* (SING); 6 miles north of Bentong, *Burkill & Haniff SFN 16537* (SING).

Perak: Kg. Tera, Grik, *Ismail KEP 95034* (KEP).

17. S. plana (Desv.) Hieron., Engl. & Prantl, Nat. Pfl. 1, 4 (1901) 703, no. 363.

Lycopodium planum Desv. ex Poir., Encycl. Suppl. 3 (1814) 554, no. 98.

Suberect; BS 3,4,6; stem base laterals distant, ascending to erect, of similar size to medians; BS laterals oblong-falcate, entire to subentire, with an auricle at the basal part of the upper margin; axillaries obovate to orbicular, strongly auriculate; medians entire, apiculate to shortly aristate; strobilus tetragonous.

Specimens examined:

Pahang: Fraser's Hill, by path to Phenological Plot, 3900 ft. alt., *Wong FRI 32046* (KEP).

Penang: Waterfall Gardens, *Nur SFN 5330* (SING).

Alston (1934) listed only one specimen, from Johore (Henderson SFN 18365).

18. S. polita Ridley, J. F. M. S. Mus. 6 (1911) 202.
S. ornata sensu Alston *p.p.* Gard. Bull. S.S. 8 (1934) 57-58. Plate 8

Suberect; BS 1,4,5, short; stem base laterals close together, spreading, larger than medians; BS laterals ovate-lanceolate, dentate with upper margin slightly to well distended basally, exauriculate; axillaries ovate, exauriculate, overlapping branches; medians dentate, acuminate to shortly aristate; strobilus bilateral but the upper-plane sporophylls only slightly longer than those of the lower plane.

The stature of the plant is smaller than that of *S. ornata*.

Specimens examined:

Pahang: Cameron Highlands, near forest station, *Poore 159* (KLU), Break Pressure Tank Hill, 4900 ft. alt., *Burkill 841* (SING), Gunong Brinchang, *Littke WL 350* (UKM), Blue Valley, *Kasim & Zai UKM 1417* (UKM); Cameron Highlands road, *Abd. Samat. b. Abdullah 331* (KLU); Fraser's Hill, 1350 m alt., *K.M. Salleh KMS 253* (UKM).

PERAK: Gunong Hijau, *Fox* s.n. Oct. 1899 (SING), 4500 ft. alt., *Haniff & Nur SFN 2459* (SING), 4750 ft. alt., *Burkill SFN 12885* (SING).

This species was previously (Alston, 1934) included under *S. ornata,* from which it is distinct (see there).

19. S. repanda (Desv.) Spring, Gaudich., Voy. Bonite Bot. 1 (1844-46) 329.
Lycopodium repandum Desv. ex Poir, Encycl. Suppl. 3 (1814) 558.

Suberect; BS 1,5, short; stem base laterals close together, spreading, larger than medians; BS laterals ovate-lanceolate, dentate and basally ciliate with basally distended upper margin, exauriculate; axillaries ovate, exauriculate, overlapping branches slightly; medians dentate with ciliate base, acuminate; strobilus tetragonous.

Specimen examined:

Perlis: *Ridley 14770* (SING).

This is one of three specimens cited by Alston (1934).

20. S. ridleyi Baker, Ann. Bot. 8 (1894) 131, no. 58.

Creeping, very little branched; BS 1; BS laterals elliptic, densely ciliate, glabrous; axillaries elliptic, densely ciliate, exauriculate, overlapping branches slightly; medians ovate, acuminate, strongly ciliate; strobilus tetragonous.

Specimen examined:

Malacca: Gunong Mering, Mt. Ophir, rocks in stream, *Ridley 3346* (SING, isotype).

Both Ridley (1919) and Alston (1934) cited only the type specimen. Ridley commented that this grew on submersed or usually wetter rocks in streams.

Recent collection at Mt. Ophir yielded only *S. alutacia* in such habitats. *S. ridleyi* would seem to be extremely rare.

21. S. rivalis Ridley, Kew Bull. (1924) 266.

Creeping; BS 1,5, short; stem laterals close together, spreading; BS laterals ovate, with blunt apex, finely ciliate, exauriculate; axillaries ovate, exauriculate, overlapping branches slightly; medians ciliolate to finely ciliate, acuminate; strobilus tetragonous.

Specimens examined:

Selangor: Logging track, 1000 ft. alt., *Evans 239* (KLU); 17th mile track, Bentong road, *Evans* s.n. 1.7.1965 (KLU).

Alston (1934) listed only three specimens and this species being endemic.

22. S. roxburghii (Hk. & Gr.) Spring, Bull. Ac. Brux. 10 (1843) 228, no. 115. *Lycopodium roxburghii* Hk. & Gr. in Hk. Bot. Misc. 2 (1831) 390, no. 135.

S. roxburghii var. **roxburghii**

Suberect; BS 3,4,5; stem base laterals close together, spreading, larger than medians; BS laterals oblong-falcate to (occasionally) ovate-lanceolate, grey-green below, ciliate at the base, with basally distended upper margin, exauriculate, glabrous; axillaries ovate, subcordate, exauriculate, overlapping branches; medians ciliolate to ciliate with arista ⅔ of to nearly the same length as lamina and sometimes longer; strobilus tetragonous.

Specimens examined:

Johore: Castlewood, *Ridley 9192* (SING); Patani, Batu Pahat, *Ridley 10984* (SING); Gunong Pulai, *Ridley 12134* (SING), *Iwatsuki, Fukuoka & Hutoh M 14168* (SING); Mt. Austin, *Ridley 12570* (SING); Kota Tinggi, *Ridley 15451* (SING); Kluang, *Holttum SFN 9238* (SING); Gunong Blumut, *Holttum SFN 10674* (SING).

Negri Sembilan: Gunong Angsi, *Ridley 11866* (SING), *Nur SFN 11502* (SING), *Holttum SFN 9930* (SING); Gunong Tampin, *Holttum SFN 9610* (SING); Senaling Inas For. Res., *Holttum SFN 9794* (SING).

Malacca: Ayer Panas, *Ridley 1616* (SING); lower part of Mt. Ophir, *Ridley* s.n. 1892 (SING).

Selangor: Ampang, lower reservoir, *Strugnell FMS 13977* (KEP); Kajang, Sg. Lalang For. Res., *Symington FMS 22792* (KEP); Ulu Langat, above Kg. Sg. Serai, *D.W. Lee UL-7* (KLU), ridge above Sg. Tekali, *D.W. Lee UL-50* (KLU), Ugul KLU 21957 (KLU).

Pahang: Gunong Raja, *Best SFN 13856* (SING).

Perak: Taiping Waterfall, *Curtis* s.n. Oct. 1895 (SING); Kledang Saiong, *Symington FMS 25800* (KEP).

Penang: Penang Hill, *Ridley 9227* (SING), *14159* (SING); Government Hill, *Curtis 3054* (SING), *3056* (SING); Penara Bukit, *Curtis* s.n. June 1895 (SING); Tiger Hill, *Sinclair SFN 39111* (SING); near Waterfall, *Ridley* s.n. Dec. 1895 (SING).

Kedah: Kuala Muda, Bt. Perah, *Shamsuddin FMS 35107* (KEP).

Trengganu: Kemaman, Bt. Kajang, *Corner SFN 32260* (SING), Sg. Jerumgaja, *Corner SFN 32261* (SING), Sg. Nipah, *Corner SFN 32268* (SING); Bundi, *Rostado SFN 11977* (SING), s.n. Feb. 1904 (SING).

Singapore: Bt. Timah, *Ridley* s.n. 28.7.1900 (SING), Nature Res., *Fukuoka S 14342* (SING).

Gard. Bull. Sing. 35(2) (1982)

Corrigendum

Replace 1st line on page 131 by:

S. **roxburghii** var. **strigosa** (Ridley) K.M. Wong, **comb. nov.**

S. *trichobasis* var. *strigosa* Ridley, J. R. As. Soc. Str. Br. 80 (1919) 153, **syn. nov.**

S. roxburghii var. **strigosa** Ridley, J. R. As. Soc. Str. Br. 80 (1919) 153.

With the upper surface of lateral leaves short hairy, especially on the basiscopic half (i.e., nearer the lower margin).

Specimens examined:

Johore: Sg. Pelepah Kiri, *Corner SFN 33570* (SING).

Kedah: Koh Moi For. Res. *Kiah SFN 35123* (SING).

Penang: Penang Hill, *Ridley 7133* (SING), *en route* from Penang Hill to Tiger Hill, *Shimizu et al M 13139* (SING), *M 13149* (SING).

This variety was recognized by Ridley (1919) but Alston (1934) reduced it, as well as *S. trichobasis* Baker, to *S. roxburghii.*

23. S. scabrida Ridley, J. R. As. Soc. Str. Br. 80 (1919) 159.
S. alutacia var. *scabrida* (Ridley) Alston, Gard. Bull. S.S. 8 (1934) 56, **syn. nov.**

Creeping; BS 1,5, short; stems hairy; stem laterals close together, spreading; BS laterals ovate-triangular, denticulate to dentate with basally distended upper margin, exauriculate, hairy on both surfaces; axillaries ovate, exauriculate, overlapping branches slightly; medians denticulate to dentate with arista half to three-quarters the lamina length; strobilus bilateral with sporophylls shortly ciliolate and hairy.

Specimens examined:

Pahang: Gunong Tahan, *Ridley 15960* (SING, isotype), *15954* (SING), Sg. Reriang, *Holttum SFN 20574* (SING).

Alston (1934) cited *Ridley 15954* to connect *S. alutacia* var. *pensile* (Ridley) Alston (see end of listing) with the ordinary form of *S. alutacia;* however, this specimen is *S. scabrida* Ridley, having the characteristics above.

24. S. selangorensis Beddome ex Ridley, J. R. As. Soc. Str. Br. 80 (1919) 148.
S. microdendron Ridley, loc. cit. 150.

Suberect, hardly 10 cm tall, with fine stoloniferous connections; BS 1,5, short; stem base laterals close together, spreading; BS laterals ovate to lanceolate, pale green below, denticulate with basally distended upper margin, exauriculate; axillaries ovate, exauriculate, overlapping branches slightly; medians denticulate, acuminate to aristate with arista half to three-quarters the lamina length; strobilus tetragonous.

Specimens examined:

Selangor: Semangkok Pass, *Ridley 12040* (SING, isotype).

Pahang: Sg. Tahan near K. Teku, *Holttum SFN 20800* (SING).

Penang: Penang Hill, *Ridley 7085* (SING, isotype of *S. microdendron* Ridl.); near Western Hill, *Holttum SFN 19312* (SING).

Apart from the smaller stature and ovate-lanceolate leaves, this may be mistaken for *S. griffithii* which has been collected in the Malay Peninsula only from Langkawi in the North-west. I could not locate the three specimens of *S.*

selangorensis var. *ciliata* Alston at Singapore, but its stoloniferous habit with basally ciliate lateral leaves (Alston, 1934) should make it distinctive.

25. S. stipulata (Bl.) Spring, Bull. Ac. Brux. 10 (1843) 145, no. 70.
Lycopodium stipulatum Bl., Enum. Pl. Jav. 2 (1830) 268, no. 18.
S. polystachya sensu Alston, Gard. Bull. S.S. 8 (1934) 46, non (Warb.) Hieron. in Engl. & Prantl, Nat. Pfl. 1, 4 (1901) 702.
S. permutata sensu Alston, Bull. Jard. Bot. Buit., ser. 3, 14 (1937) 175.

Suberect; BS consistently 2; leaves of main stem similar in size to, or slightly larger than those of BS, spreading to ascending; BS laterals oblong-falcate, entire, not auriculate; axillaries along the main stem conspicuously larger than laterals, ovate to suborbicular, exauriculate, overlapping branches; medians entire, acuminate to apiculate to shortly aristate; strobilus tetragonous.

Specimens examined:

Johore: Sg. Pelepah Kiri, *Corner 33567* (SING); Lombong Waterfall, North of Kota Tinggi, *Abd. Samat b. Abdullah 539* (KLU).

Negri Sembilan: Gunong Angsi, *Wong FRI 32056* (KEP); Jeram Toi, *Ramli RY 7* (UKM); Ulu Kelewang, *D.W. Lee* s.n. (KLU).

Selangor: Batu Perdinding, *Nur* s.n. 2.11.1937 (SING); Sg. Lalang For. Res., *Symington FMS 22794* (KEP); Ulu Langat, *D.W. Lee & Ugul KLU 21962* (KLU), JKA catchment area above Kg. Sg. Serai, *D.W. Lee UL-2* (KLU), *UL-3* (KLU); Ampang, lower reservoir, *Strugnell FMS 13976* (KEP), Intake catchment reserve, *Wong FRI 32224* (KEP); Gombak, 1200 m alt., *Ramli RY 8* (UKM), Ulu Gombak, 22nd mile, *Stone 5733* (KLU), roadside, *Wyatt-Smith KEP 55802* (KEP); University of Malaya campus, Rimba Ilmu, *Low 90* (KLU).

Pahang: Genting Simpah, *Stone 7431* (KLU), *Nur SFN 34282* (SING), *Poore 241* (KLU), *Poore 263* (KLU); Sg. Cheka, *Holttum SFN 24770* (SING); Fraser's Hill, *Poore 41* (KLU), *Shimizu et al M 13844* (SING), 1350 m alt., *Md. Sarif* s.n. 17.12.1981 (UKM); Cameron Highlands, top of Gunong Brinchang, *Stone 5583-A* (KLU); Sg. Teku, *Kiah SFN 31708* (SING).

Perak: Path to Gunong Bujong Melaka, *Md. Shah & A. Shukor MS 3380* (KEP, SING); Kledang Saiong, *Symington KEP 25699* (KEP), *Sow FMS 33665* (KEP); Gunong Bubu For. Res., *Hou 639* (KEP).

Trengganu: Kemaman, Bt. Kajang, *Corner SFN 30387* (SING), Sg. Nipah, *Corner SFN 32266* (SING); Ulu Brang, *Kiah SFN 33813* (SING); Gunong Padang, *Kiah SFN 33946* (SING).

Kelantan: Bt. Chemaya, *Henderson SFN 19479* (SING); Pasir Depok, *Haniff & Nur SFN 10212* (SING); K. Mering, Sg. Brok, *Ng FRI 5471* (KEP).

While enumerating species in the Malay Peninsula, Alston (1934) listed *S. polystachya* as being present, and under this he noted a possible variety which is 'more slender' with 'stem leaves smaller, often spreading' and 'spikes usually solitary.' Later, he considered that the Malayan species in question had been wrongly referred to *S. polystachya* and was in fact identical to *S. permutata* (Alston, 1937). He also noted that *S. stipulata* was the correct identity of the variety he had earlier (Alston, 1934) placed under *S. polystachya*. These two taxa recognized by Alston (1934; 1937) are in fact conspecific, the size of leaves being variable, and the shape of the axillary leaf varying from ovate to suborbicular. The earliest name *S. stipulata* is adopted for this single species.

26. S. strigosa Beddome, Kew Bull. (1911) 192, no. 600.

Creeping; BS 1,2,5, short; stem laterals close together, spreading; BS laterals ovate, ciliate with basally distended upper margin, exauriculate, hairy on upper surface to both surfaces; axillaries ovate to elliptic, exauriculate, not or slightly overlapping branches; medians ciliate with arista nearly as long as lamina; strobilus tetragonous.

Specimens examined:

Johore: Kluang, Gunong Blumut, *Ng KEP 98051* (KEP).

Negri Sembilan: Gunong Angsi, Ulu Pedas, *Nur SFN 11721* (SING).

Selangor: Genting Bidai, *Ridley 7815* (SING), *7825* (SING); Klang Gates, *Ridley 13442* (SING), *Sinclair SFN 40140* (KEP).

27. S. wallichii (Hk. & Gr.) Spring, Mart. Fl. Bras. 1, 2 (1840) 124.
Lycopodium wallichii Hk. & Gr. in Hk. Bot. Misc. 2 (1831) 384, no. 106.
Plate 5

Stiffly erect; BS consistently 1; stem base laterals distant, ascending, of similar size to medians; BS laterals oblong-falcate, entire, not or (rarely) slightly auriculate at base of upper margin; axillaries ovate to elliptic, exauriculate, not overlapping branches; medians entire, acuminate to apiculate; strobilus tetragonous.

Specimens examined:

Johore: near Gunong Panti, *Audas* s.n. 31.8.1941 (SING).

Negri Sembilan: Pasoh For. Res., *Evans 222* (KLU).

Selangor: Semenyih, *Hume 7819* (SING); Kajang, Sg. Lalang For. Res., *Symington FMS 24071* (KEP); Bt. Cheraka For. Res., *Jabil KEP 77654* (KEP); Sg. Buloh, *Burkill SFN 11870* (SING) Klang Gates, *Hume 7235* (SING); Genting Simpah, *Turnau 778* (KLU), 12th mile, *Strugnell FMS 13083* (KEP), 21½ mile, *Sinclair 9835* (SING); Gunong Bunga Buah, Seraya-rich ridge, 2700 ft. alt., *Wong FRI 32226* (KEP); Gombak, University of Malaya Field Centre, *Jayamohan s.n. 8.8.1974 (KLU) off 19th mile, Wong FRI 32071* (KEP); Ulu Langat, *Ugul KLU 21960* (KLU), at head of Sg. Langat drainage, *D.W. Lee UL-51* (KLU).

Pahang: Kota Glanggi, *Henderson SFN 22495* (SING); Jengka For. Res., *Poore 1416* (KLU); near Sg. Endau, *Betty & Latiff KLU 18597* (KLU); Fraser's Hill, *Burkill 2067* (SING); Sg. Handerik, Ulu Serau, *Osman FMS 28320* (KEP); K. Trenggan, *Stone & Wong KLU 13886* (KLU).

Perak: Maxwell's Hill, *Wray Jr. 23* (SING); Gunong Bujang, *Evans 25* (KLU).

Kedah: K. Muda, Bt. Perak, *Samsuddin FMS 33142* (KEP).

Trengganu: Kemaman, Sg. Nipah, *Corner SFN 32269* (SING).

28. S. willdenowii (Desv.) Baker, Gard. Chron. (1867) 783.
Lycopodium willdenowii Desv. ex Poir., Encycl. Suppl. 3 (1814) 540, no. 87.
Plate 3

Suberect, often scrambling over other vegetation; BS 3,4; stem base laterals distant, ascending, of similar size to medians; BS laterals oblong-falcate, often bluish above, entire, with an auriculate fold at the basal part of the upper margin; axillaries ovate to elliptic, strongly auriculate; medians entire, acuminate; strobilus tetragonous.

Specimens examined:

Johore: Gunong Pulai, *Iwatsuki, Fukuoka & Hutoh M 14153* (SING); Gunong Pantai *Kiew RK-KBH 622* (UPM).

Negri Sembilan: Bt. Tampin, *Goodenough 1863* (SING); Ulu Klewang, *D.W. Lee* s.n. 21.11.1973 (KLU).

Selangor: Genting Simpah, *Hume 8547* (SING); Gua Batu, limestone, *Chin 325 (KLU); Ulu Langat, D.W. Lee & Ugul KLU 21959* (KLU)l above Kg. Sg. Serai, *D.W. Lee UL-1* (KLU); Bt. Lagong pipeline path, *Frodin FRI 3597* (KEP).

Pahang: P. Tioman, between Kg. Tekek & Kg. Juara, *D.W. Lee* s.n. (KLU), Ayer Besar, *Henderson SFN 18753* (SING); 31st mile Bentong road, *Turnau 897* (KLU); Taman Negara, K. Trenggan, *Stone & Wong KLU 13888* (KLU).

Perak: Changkat Jong For. Res., *Haniff FMS 47515* (KEP); Kledang Saiong, *Symington FMS 25700* (KEP).

Kedah: Langkawi, Bt. Sawak For. Res., *Nor FMS 31393* (KEP).

Singapore: *Cantley 143* (SING); Bt. Timah, *Ridley* s.n. Feb. 1890 (SING).

Doubtful entity

S. alutacia var. **pensile** (Ridley) Alston, Gard. Bull. S.S. 8 (1934) 56.

Alston (1934) gave the distinguishing features as 'an extreme form with larger, more acute leaves,' while Ridley (1919) described this as having 'leaves of lower plane about 0.08 in.' compared to 'leaves of lower plane... 0.05 in.' for *S. alutacia.*

In the Gardens Herbarium, Singapore, are specimens determined by Alston and listed (1934) by him as just *S. alutacia,* which have leaves reaching the size quoted for *S. pensile* Ridley and perhaps qualify as this; however, some leaves on these specimens have sizes smaller than that given by Ridley (1919) — in all aspects these specimens are similar to ordinary *S. alutacia.* The specimens concerned are:

Selangor: Rawang, *Ridley 7821* (SING).

Pahang: Gunong Tahan, *Robinson 5375* (SING).

Kedah: Kedah Peak, *Flippance* s.n. Nov. 1932 (SING), *Holttum & Haniff SFN 14900* (SING).

The type of *S. pensile* Ridley is at Kew (*Yapp,* s.n. Perak, Gunong Inas) and there are no specimens determined by Ridley or Alston as either *S. pensile* Ridley or *S. alutacia* var. *pensile* (Ridley) Alston respectively, available at Singapore.

Acknowledgements

I thank Dr. A.C. Jermy for his comments and discussion on the manuscript, and for checking out details of specimens at the British Museum (Natural History) on my behalf. Dr. Chang Kiaw Lan and Prof. R.E. Holttum have been most encouraging regarding the undertaking of this study during the author's spare time. The Keepers of the herbaria at Singapore, University of Malaya, Universiti Kebangsaan

Malaysia and Universiti Pertanian Malaysia have kindly allowed the loan and study of specimens in their care.

References

Alston, A.H.G. (1934). The genus *Selaginella* in the Malay Peninsula. *Gard. Bull. S.S.* 8: 41-62.

——— (1934b). The *Selaginellae* of the Malay Islands. I. Java and the lesser Sunda Islands. *Bull. Jard. Bot. Buit.*, ser. 3, 13: 432-442.

——— (1937). The *Selaginellae of the Malay Islands. II. Sumatra. Bull. Jard. Bot. Buit.*, ser. 3, 14: 175-186.

Boodle, L.A. (1901). Comparative anatomy of the Hymenophyllaceae, Schizaeaceae and Gleicheniaceae. *Ann. Bot.* 15: 703-747.

Foster, A.S. & E.M. Gifford, Jr. (1974). *Comparative Morphology of Vascular Plants*. 2nd. ed.:39-40. San Francisco: Freeman & Co.

Jermy, A.C., K. Jones & C. Colden (1967). Cytomorphological variation in *Selaginella. J. Linn. Soc.* (Bot.) 60, 382: 147-158.

Krishnan, J. (1975). Physiological Leaf Anatomy of *Selaginella*. B. Sc. Honours Thesis in Botany, Faculty of Science, University of Malaya, Kuala Lumpur.

Lee, D.W. (1977). On Iridescent Plants. *Gard. Bull. Sing.* 30: 21-29.

Mukherjee, R.N. & U. Sen (1981). A Forked Vein and Foliar Fibres in *Selaginella. Fern Gaz.* 12: 175-177.

Ridley, H.N. (1919). The Fern-Allies and Characeae of the Malay Peninsula. *J. R. As. Soc. Str. Br.* 80: 139-161.

Sasaki, S., C.H. Tan & Zolfatah Rahman (1978). Physiological Studies on Malaysian Tropical Rainforest Species. Unpublished report, Forestry Department, Peninsular Malaysia. 181 pp.

The Limestone Hiil Flora of Malaya III*

S.C. CHIN
Botany Department, University of Malaya,
Kuala Lumpur, Malaysia.

Angiosperms — Dicotyledons *cont.*

INTRODUCTORY KEY TO RUBIACEAE

The numbers on the right hand side refer to the numbers in the subsequent main key with which one should continue.

1. Epiphytic, tuberous shrub ..... *Hydnophytum formicarium.*
1. Not as above

2. Scandent: climbers or twiners 3
Morinda umbellata, Panderia tomentosa, Psychotria cantleyi, Psychotria sarmentosa.
2. Erect: herbs, shrubs or trees

3. Herbaceous, sometimes woody at the base

4. Stem creeping 7
Geophila repens, Hedyotis coronaria, Ophiorrhiza longerepens.
4. Stem not creeping

5. Corolla rotate, anthers connivent 11
Argostemma pictum, A. diversifolium, A. inaequilaterum.
5. Corolla and anthers different

6. Flowers secund, capsule usually obcordate 14
Ophiorrhiza spp.
6. Flowers differently arranged, capsule not obcordate 20
Oldenlandia spp., *Hedyotis* spp.

3. Woody, shrubs or trees

7. Sea-shore tree, leaves large, usually subcordate .....
..... *Guettarda speciosa.*
7. Not on sea-shores

8. Flowers in dense heads, fruits compound 27
Morinda elliptica, Nauclea junghuhnii, Neonauclea calycina.
8. Flowers not in dense heads, fruits not compound.

9. Flowers in terminal inflorescences

10. Corolla tube 2-3 cm long, petals 4, style hardly projecting 31
Ixora spp.
10. Corolla tube very short, sometimes to 1.3 cm long, petals 4 to 5, style short or projecting to 2.5 cm

11. Leaves, lower surface pubescent 41
Psychotria rhinocerotis, Mycetia malayana, Pavetta naucleiflora, Tarenna appressa.
11. Leaves, glabrous

---

* Parts I and II appeared in Gardens' Bulletin, XXX (1977) 165-219, and XXXII (1979) 64-203, respectively.

12. Style projecting 1-2.5 cm 45
Pavetta pauciflora, Pavetta indica.
12. Style not or hardly projecting 46
Tarenna spp., *Prismatomeris malayana, Becheria parviflora, Psychotria* spp.

9. Flowers in axillary inflorescences; if terminal, then only 1-3 flowers together

13. Lower surface of leaves pubescent 57
Lasianthus stipularis var. *hirtus, Petunga hirta, Urophyllum corymbosum, Canthium aciculatum, Timonius atropurpureus.*
13. Lower surface of leaves pubescent 57
Lasianthus stipularis var. *hirtus, Petunga hirta, Urophyllum corymbosum, Canthium aciculatum, Timonius atropurpureus.*

RUBIACEAE — MAIN KEY

1. Epiphytic, tuberous shrub ..... *Hydnophytum formicarium*
Not as above 2

2. Scandent: climbers or twiners 3
Erect: herbs, shrubs or trees 6

3. Flowers in dense globose heads; fruits multiple ..... *Morinda umbellata*
Flowers not in dense globose heads; fruits not multiple 4

4. Inflorescence ± 10 cm long, corolla ± 1 cm long ..... *Paederia tomentosa*
Inflorescence smaller, corolla short: 0.3-0.4 cm long 5

5. Inflorescence compact; seeds with 3 ridges ..... *Psychotria cantleyi*
Inflorescence spreading; seeds with 4 ridges ..... *Psychotria sarmentosa*

6. Herbaceous, sometimes woody at the base 7
Woody, shrubs or trees 25

7. Stem, creeping, with ascending branches 8
Stem, erect 10

8. Leaves cordate ..... *Geophila repens*
Leaves not cordate 9

9. Flowers in sessile heads; fruits subglobose or globose ..... *Hedyotis coronaria*
Flowers not in heads; fruits oblong, broader than long, slightly obreniform .....
..... *Ophiorrhiza longerepens*

10. Corolla rotate, anthers connivent; inflorescence terminal 11
Corolla and anthers different; inflorescence terminal or axillary 13

11. Leaves ovate or lanceolate, base narrowed, rarely rounded 12
Leaves broadly ovate or suborbicular, base rounded or cordate ..... *Argostemma pictum*

12. Leaves ovate, broadest at the lower portion; 2-6 in a pseudowhorl .....
..... *Argostemma diversifolium*
Leaves lanceolate, broadest at the middle or slightly above it, 6-10, at the top of stem .....
..... *Argostemma inaequilaterum*

13. Flowers secund (on one side only) on inflorescence-branches; capsule compressed, usually obcordate 14
Flowers not so arranged; capsule ovoid, globose or otherwise shaped, not compressed or .....
obcordate 20

14. Lower surface of leaves glabrous, or sometimes minutely pubescent on the veins only 15
Lower surface pubescent 17

15. Upper surface glabrous 16
Lower surface finely pubescent ..... *Ophiorrhiza fruticosa*

16. Top of capsule broadly V-shaped; parts of plant drying pink. Common in Selangor .....
..... *Ophiorrhiza discolor*
Top of capsule almost flat; plant not drying pink. Only from Kelantan .....
..... *Ophiorrhiza remotiflora*

17. Upper surface of leaves pubescent; capsule golden-pubescent ..... *Ophiorrhiza kunstleri*
Upper surface of leaves glabrous or glabrescent; capsule glabrous or glabrescent 18

18. Top of capsule depressed, capsule obcordate or obreniform 19
Top of capsule more or less flat ..... *Ophiorrhiza communis*

19. Leaves with base tapered, both of a pair usually equal-sized ..... *Ophiorrhiza hispidula*
Leaves, with base rounded or shortly cuneate, one of a pair usually smaller .....
..... *Ophiorrhiza pallidula*

20. Flowers in axillary clusters, few or many to a cluster 21
Flowers in terminal, lax inflorescences 24

21. Capsule 4-winged, splitting horizontally above the calyx ..... *Oldenlândia pterita*
Capsule not winged, splitting vertically 22

22. Leaves small, 1.5-5.0 cm long 23
Leaves bigger, 6-12 cm long ..... *Hedyotis congesta*

23. Leaves thin, 0.5-1.2 cm wide, more or less hispid ..... *Hedyotis verticillata*
Leaves coriaceous, 0.3-0.8 cm wide, glabrous ..... *Hedyotis tenelliflora*

24. Anthers about 0.5 mm long ..... *Oldenlandia ovatifolia*
Anthers about 1.25 mm long ..... *Oldenlandia rosettifolia*

25. Sea-shore tree, leaves large, 10-25 by 8-18 cm, usually subcordate; fruits woody, ± 2.5 cm across
..... *Guettarda speciosa*
Not on sea-shores (but sometimes on coastal limestone), leaves usually smaller, fruits different
..... 26

26. Flowers in dense heads; fruit compound 27
Flowers not in dense heads though sometimes in compact clusters; fruit not compound 29

27. Heads oblong, bumpy, fleshy, axillary ..... *Morinda elliptica*
Heads globose, not bumpy, dry, terminal 28

28. Heads small, ±1.2 cm across (in flower) and to 2 cm across (in fruit), ebracteate .....
..... *Nauclea junghuhnii*
Heads larger, 2-3.5 cm across, subtended initially by a pair of large bracts .....
..... *Neonauclea calycina*

29. Flowers in terminal clusters, spikes or panicles 30
Flowers in axillary clusters, spikes or panicles, or solitary; if terminal then only 1-3 together 56

30. Corolla-tube 2-3 cm long (0.8-1.3 cm in *Ixora nigricans*), petals 4, style short or projecting less than 0.6 cm 31
Corolla-tube very short, sometimes to 1.3 cm long and very rarely to 1.8 cm long, petals 4 or 5, style short or projecting to 2.5 cm 40

31. Leaves, lower surface pubescent 32
Leaves, lower surface glabrous 33

32. Sepals ovate, 0.6 cm long, known only from Pahang ..... *Ixora clerodendron*
Sepals filiform, 0.2-0.5 cm long. Recorded from NW. Malaya, not known from Pahang .....
..... *Ixora brunonis*

33. Corolla white or greenish, fragrant 34
Corolla yellow, pink or red, fragrant or not 36

34. Sepals oblong, 0.3-0.6 cm long ..... *Ixora umbellata*
Sepals ovate-lanceolate, ±0.1 cm long 35

35. Leaf-base tapered; corolla-tube 0.8-1.3 cm long ..... *Ixora nigricans*
Leaf-base usually rounded; corolla-tube 2-3 cm long ..... *Ixora nigricans* var. *ovalis*

36. Corolla tube wholly yellow, pink or red, petals yellow or orange, changing to red 37
Corolla tube tinged pink or red, petals white or pinkish, colour not changing 39

37. Leaf-base tapered 38
Leaf-base cordate ..... *Ixora scortechinii*

38. Leaves lanceolate 0.7-2.3 cm wide ..... *Ixora lobbii* var. *stenophylla*
Leaves broadly elliptic, 5-15 cm wide ..... *Ixora congesta*

39. Inflorescence erect, peduncle 5-9 cm long ..... *Ixora grandifolia*
Inflorescence pendulous, peduncle to 28 cm long ..... *Ixora pendula*

40. Leaves, lower surface pubescent, especially on the veins 41
Leaves glabrous 44

41. Pubescence rusty brown, upper surface of leaves glabrous, pale grey when dry; veins 12-15 pairs, raised and prominent on the lower surface ..... *Psychotria rhinocerotis*
Pubescence not rusty brown and characters not so combined 42

42. Corolla-tube very short, 0.2 cm; fruits subglobose, white, pulpy; leaves membranous; twigs straw-coloured ..... *Mycetia malayana*
Corolla-tube longer, 0.7-1.3 cm; fruits not white and pulpy 43

43. Style projecting 1.2cm beyond the corolla tube, corolla lobes 4; leaves membranous ..... *Pavetta naucleiflora*
Style not projecting beyond the corolla-tube, corolla-lobes 5, sometimes 4; leaves thinly coriaceous ..... *Tarenna appressa*

44. Style projecting 1-2.5 cm beyond the corolla-tube, leaves thin; corolla-tube about 1.2 cm long ... 45
Style not or hardly projecting; leaves various; corolla-tube usually shorter 46

45. Cymes lax, peduncle 4 cm long; endemic to Gua Batu, Selangor ..... *Pavetta pauciflora*
Cymes dense, peduncles less than 4 cm; common in lowland forest, on limestone in Perlis ..... *Pavetta indica*

46. Corolla-lobes contorted or imbricated (see in bud) 47
Corolla-lobes valvate (see in bud) 51

47. Corolla-tube 1-1.2 cm long; leaves broadly lanceolate-obovate ..... *Tarenna pulchra*
Corolla-tube less than 0.5 cm long 48

48. Leaves elliptic, elliptic-lanceolate, lanceolate-obovate or oblong-lanceolate 49
Leaves ovate-cuspidate ..... *Tarenna calcarea*

49. Leaves smallish, 2-9 cm long 50
Leaves large, 13-18 cm long ..... *Tarenna ridleyi*

50. Corolla-lobes contorted ..... *Tarenna curtisii*
Corolla-lobes imbricate ..... *Tarenna angustifolia*

51. Corolla-tube less than 0.5 cm long 52
Corolla-tube 1.2-1.8 cm long ..... *Prismatomeris malayana* (in part)

52. Style bifid 53
Style not bifid, more or less clubbed ..... *Becheria parviflora*

53. Corolla lobes 5 54
Corolla lobes 4 ..... *Psychotria rostrata*

54. Seeds with 1 ridge, sometimes very faint 55
Seeds with 5 ridges ..... *Psychotria viridiflora*

55. Leaves membranous; ridge very faint ..... *Psychotria montana*
Leaves coriaceous; ridge prominent ..... *Psychotria angulata*

56. Leaves on lower surface pubescent, sometimes on the veins only 57
Leaves on lower surface glabrous, rarely with small tufts of hair in the axil of lateral veins 61

57. Leaves exceeding 10 cm long 58
Leaves 3-8 cm long 60

58. Flowers surrounded by numerous lanceolate hairy bracts ..... *Lasianthus stipularis*
Flowers not surrounded by such bracts 59

59. Flowers in short spikes; leaves about 11 cm long ..... *Petunga hirta*
Flowers in umbelled cymes; leaves 12-25 cm long ..... *Urophyllum corymbosum*

60. Leaves pubescent, also with needle-like spins ..... *Canthium aciculatum* (in part)
Leaves pubescent, without spines, thin, surface uneven when dry; fruit on a stalk 1.5-2.5 cm long ..... *Timonius atropurpureus*

61. Both leaves of a pair the same size 62
One leaf of a pair smaller; flowers 1-2 together, terminal or in the axils of the terminal pair of leaves ..... *Amaracarpus saxicola*

62. Length of leaves double the width or less 63
Length of leaves usually exceeding 2.5 times the width 64

63. Shrub, spiny; fruits 0.6 cm long ..... *Canthium aciculatum* (in part)
Tree or shrub, not spiny; fruits 0.7-1.3 cm long ..... *Canthium didymum*

64. Corolla-tube 0.5 cm or more long 65
Corolla-tube very short; fruit bright orange ..... *Urophyllum glabrum*

65. Leaves 6-12 cm long 66
Leaves 15-30 cm long 67

66. Pedicels 1.2-2 cm long; fruits 0.6 cm across; a shrub ..... *Prismatomeris malayana* (in part)
Pedicels very short: 0.1-0.3 cm long; fruits 0.6-1.1 cm across; a tree ..... *Randia densiflora*

67. Corolla tube 0.9-1.2 cm long, lobes 5-7, longer than or as long as the tube; fruits 0.8-1.5 cm long ..... *Coffea canephora*
Corolla tube longer, lobes 5, shorter than the tube; fruits smaller ..... *Coffea malayana*

Amaracarpus saxicola Ridl., J. Str. Br. As. Soc. 61 (1912) 22; Fl. 2 (1923) 172; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 48.

Shrub 1-2 m tall. Leaves mostly in unequal pairs, subcoriaceous, glabrous, ovate, ovate-elliptic, elliptic or elliptic-lanceolate, 2.5-7 by 1-3 cm; petiole: 0.1-0.3 cm long; stipules toothed. Flowers solitary in the axils of terminal pairs of leaves, small and white. Fruit oblong or obovate, deep blue when ripe.

Endemic and restricted to limestone. Rare. Previously known only from Kamuning, Perak, now recorded from Kelantan and Pahang.

Argostemma diversifolium Ridl., J. Str. Br. R. As. Soc. 57 (1910) 52; Fl. 2 (1923) 23; Craib, Fl Siam 2 (1923) 28; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 48.

Succulent herb to 1.5 m tall. Leaves 2-6 in a pseudowhorl, two of a pair often slightly unequal in size, ovate-acute or ovate-lanceolate, glabrous, dark-green above and pale below, 5-12 by 3-7 cm. Cymes terminal, 4-7 cm long, lax. Pedicels 1.2 cm long, stamens 0.8 cm long, longer than petals.

Distributed in Peninsular Thailand. In Malaya, known from a single specimen from Lenggong limestone in Perak (Ridley 14479). A rare and relatively unknown plant.

Argostemma inaequilaterum Benn., Pl. Jav. Rar. 1 (1838) 95; Ridl., Fl. 5 (1925) 314; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 49.
A. acuminatum King, in Ridl., Fl. 2 (1923) 23.

Endemic and rare, recorded on limestone from Perak and Selangor and once (not limestone) from Penang.

Argostemma pictum Wall., in Roxb., Fl. Ind. 2 (1824) 327; Hk.f., F.B.I. 3 (1880) 43; Ridl., Fl. 2 (1923) 24; Craib. Fl. Siam 2 (1932) 30; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 49.

Succulent herb to 12 cm tall. Leaves usually 4 of which 2 are small and 2 large, broadly ovate to suborbicular; base broad or subcordate; 2.5-9 by 3-6 cm. Flowers in terminal umbels. Anthers 5, connate.

Distributed in Phuket, Peninsular Thailand. Uncommon in Malaya, ofen on limestone.

Bacheria parviflora Ridl., J. Str. Br. R. As. Soc. 61 (1912) 20; Fl. 2 (1923) 21; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 49.

Canthium aciculatum Ridl., J. Str. Br. R. As. Soc. 57 (1910) 57, Fl. 2 (1923) 124; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 49.

Shrub; finely appressed hairy and with needle-like spines up to 1.2 cm long. Leaves ovate or lanceolate, base round, about 5 by 2.5 cm. Flowers small, in axillary cymes of 2-3 together. Calyx cupular, corolla-tube silky hairy. Berry 0.6 cm long.

Endemic to limestone, Known from Lenggong, Perak; Gunong Keriang, Kedah and Kelantan.

Canthium didymum Roxb., Fl. Ind. 1 (1832) 535; Hk.f., F.B.I. 2 (1880) 132;

Coffea canephora Pierre ex Froehner, sensu Purseglove, Trop. Crops Dicots. 2 (1968) 482.
C. robusta Lind., in Corner, Ways. Trees 1 (1952) 537; Burkill, Dict. Econ. Prod. Mal. 1 (1966) 636.

Native to tropical Africa. Now cultivated over most of the Tropics especially in Asia and Africa. What appears to be this species has been recorded from the lower slopes of Gunong Pondok. There is a patch of about 30-50 square metres on the broad saddle of this hill facing the main road that passes Padang Rengas, Perak. The soil here is a rich rusty red and fairly abundant. The trees occur in an almost pure stand and were apparently healthy; 3-7 m tall and fruiting and flowering sparingly when found (12th March 1971). How they reached there is a mystery. The local residents we met informed us that there is no coffee cultivation anywhere nearby which could have provided the source of this stand, neither do they know of

the existence of these trees. Nevertheless they are probably escapes from cultivation, perhaps from a distance away or perhaps from nearby cultivation unknown to the residents we inquired from. Whatever the origin, the trees certainly deserve a further investigation.

Coffea malayana Ridl., J. Str. Br. R. As. Soc. 61 (1912) 19, Fl. 2 (1923) 111; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 49.

Endemic, not common, in lowland forest. Once from limestone on Gunong Pondok, Perak *(Henderson 23808)*.

Geophila repens (L.) Johnston, Sargentia 8 (1949) 281; Back. & Bakh. f., Fl. Java 2 (1965) 334.
G. herbacea (Jacq.) O.K., Rev. Gen. Pl. (1891) 300; Craib, Fl. Siam 2 (1934) 205; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 49.
G. reniformis Don, Prodr., Fl. Nepal (1825) 136.
Rondeletia repens L., Syst. ed. 10 (1789) 928.

Guettarda speciosa L., Sp. Pl. (1753) 991; Ridl., Fl. 2 (1923) 112. Henders., J. Mal. Br. R. As. Soc. 17 (1939) 49; Stone, Micronesica 6 (1970) 544.

Distributed along the coasts of Tropical Asia, East to the Pacific Islands and North to Taiwan. Recorded from coastal limestone in Langkawi.

Hedyotis congesta R. Br. ex Don, Gen. Syst. 3 (1834) 526; Ridl., Fl. 2 (1923) 51.

Hedyotis coronaria (Kurz) Craib, Fl. Siam, 2 (1932) 38; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 49.
H. coronata Wall., in Ridl., Fl. 2 (1923) 48.

Slender decumbent herb, 15-20 cm tall. Leaves oblong-acuminate, glabrous except for the puberulent midrib below, 4-6.5 by 0.8-2 cm. Inflorescence in a terminal head of 4 leaves, sessile. Calyx-lobes lanceolate. Corolla 0.6 cm long. Fruit ellipsoid, many-seeded.

Distributed in Burma, SE. China and Thailand. Not uncommon in lowland to hill forest in Malaya. Often on limestone.

Hedyotis tenelliflora Bl., Bijdr. (1826) 971; Ridl., Fl. 2 (1923) 51; Craib, Fl. Siam 2 (1932) 49; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 49; 2 (1932) 49.

Hedyotis verticillata (L.) Lamk., Tabl. Encycl. 1 (1791) 271; Craib, Fl. Siam 2 (1932) 51.
H. hispida Retz., in Ridl., Fl. 2 (1923) 52.
Oldenlandia verticillata Linn., in Henders., J. Mal. Br. R. As. Soc. 17 (1939) 50.

Hydnophytum formicarum Jack, Trans. Linn. Soc. 14 (1823) 124; Ridl., Fl. 2 (1923) 172; Henders., Mal. Wild Fls. Dicots. (1959) 225.

Ixora brunonis Wall. ex Don, Gen. Syst. 3 (1834) 573; Ridl., Fl. (1923) 91; Craib, Fl. Siam 2 (1934) 151; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 49; Corner, Gard. Bull. S. S. 11 (1941) 183.

Ixora clerodendron Ridl., Trans. Linn. Soc. 3 (1893) 311, Fl. 2 (1923) 91; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 49; Corner, Gard. Bull. S. S. 11 (1941) 185.

A small, little branched shrub. Leaf lanceolate or obovate, glabrous above, pubescent beneath, 23 by 9 cm. Inflorescence a terminal corymb, 2.5 cm across; corolla white, 2.5 cm long, lobes 0.3 cm long. Fruit 0.6 cm long.

Endemic and rare, usually on limestone, and known only from Pahang.

Ixora congesta Roxb., Fl. Ind. 1 (1820) 397; Ridl., Fl. 2 (1923) 93; Craib, Fl. Siam (1934) 154; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 49; Corner, Gard. Bull. S.S. 11 (1941) 189.

Ixora grandifolia Zoll. & Mor., Syst. Verz. (1846) 65; Corner, Gard. Bull. S.S. 11 (1941) 197.
I. crassifolia Ridl., Fl. 2 (1923) 98.
I. elliptica Ridl., l.c. 98.
I. fluminalis Ridl., l.c. 97.

Ixora lobbii King et Gamble, Mats. 15 (1904) 78; Corner, Gard. Bull. S.S. 11 (1941) 216.
var. *stenophylla* Corner, l.c. 216.
I. stenophylla (Korth.) Kuntze sensu Ridley, Fl. 2 (1923) 94.

Ixora nigricans Wight & Arn. Prodr. Fl. Ind. 1 (1834) 428; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 49; Corner, Gard. Bull. S.S. 11 (1941) 223.
var. *ovalis* Pitard, Fl. Gen. Indoch. 3 (1924) 322; Corner, Gard. Bull. S.S. 11 (1941) 224.

Ixora pendula Jack, Mal. Misc. 1 (1820) 11; Ridl., Fl. 2 (1923) 95; Craib, Fl. Siam 2 (1934) 164; Henders., J. Mal. Br. R. R. As. Soc. 17 (1939) 49; Corner, Gard. Bull. S.S. 11 (1941) 226.
I. pendula var. *opaca* Ridl., l.c. 96.

Ixora scortechinii K. & G., Mats. 15 (1904) 71; Corner, Gard. Bull. S.S. 11 (1941) 230.
I. humilis K. & G. var. *scortechinii* Ridl., Fl. 2 (1923) 95.

Endemic, fairly common in lowland forest, with only one record from limestone. (Gua Panjang, Kelantan, *Henderson 19518).*

Ixora umbellata Koord. et Valet., Bijdr. Booms. Java 8 (1902) 162; Corner, Gard. Bull. S.S. 11 (1941) 232.
var. *multibracteata* Corner, l.c. 234.
I. multibracteata K. & G. Mats. 15 (1904) 74.

Knoxia corymbosa Willd., Sp. Pl., 1 (1798) 582; King, Mats.; 15 (1904) 57; Ridl., Fl. 2 (1923) 177; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 49.

Lasianthus stipularis Bl., Bijdr. (1826) 997; Ridl., Fl. 2 (1923) 152; Craib, Fl. Siam 2 (1934) 218; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 50.
var. *hirtus* Ridl., Fl. 2 (1923) 153.

Morinda elliptica Ridl., J. Str. Br. R. As. Soc. 79 (1918) 86, Fl. 2 (1923) 118; Corner, Ways. Trees 1 (1952) 550.

Morinda umbellata L., Sp. Pl. 1 (1753) 176 Ridl., Fl. 2 (1923) 119; Craib, Fl. Siam 2 (1934) 180; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 50, Mal. Wild Fls. Dicots (1959) 219.

Woody climber. Leaves glabrous, elliptic, elliptic-oblong or elliptic-lanceolate, chartaceous or thinly coriaceous, 7-12 by 2-4 cm; sometimes larger. Flowers several to many, densely crowded in terminal heads, 5-12 together, each on a peduncle 1.2-3.5 cm long. Calyx truncate or minutely denticulate; corolla white, throat villous, 0.2 cm long. Fruit a bumpy syncarp, ripening orange, 0.8-2 cm across.

Distributed all over tropical Asia, to S. China, S. Japan and Taiwan, and South-East to Australia. What appears to be a variant of this species has been recorded from limestone in Kedah, Kelantan, Pahang, Perak and Selangor, being common on Bukit Takun and Gua Musang.

This plant is smaller, 1-2 (-3) m long. Leaves elliptic, elliptic-obovate or elliptic-lanceolate, smaller, 4-9 by 1.1-3 (-4) cm. The upper surface varies from glabrous to sparsely or densely hispidulous, the lower surface more or less hispidulous. Flower heads fewer, 1-3 (-5) and ech bears only 3-8 flowers; peduncle short, 0.3-1 cm. The floral structure, however, appears the same. Syncarps smaller, 0.8-1.2 cm across.

Found usually in fairly exposed, dry places; climbing on shrubs or over rocks.

Mycetia malayana Craib, Kew Bull. (1914) 29, Fl. Siam, 2 (1932) 80; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 50, Mal. Wild Fls. Dicots. (1959) 214.
Adenosacme malayana Wall ex Ridl., Fl. 2 (1923) 63.

Nauclea junghuhnii Merr., J. Wash. Acad. Sc. 5 (1915) 536; Craib, Fl. Siam 2 (1932) 6; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 50; Corner, Ways. Trees 1 (1952) 551.
Sarcocephalus junghuhnii Miq., in Ridl., Fl 2 (1923) 7.

Neonauclea calycina Merr., J. Wash. Acad. Sc. 5 (1915) 539; Craib, Fl. Siam 2 (1932) 14.
N. purpurascens Ridl., Fl. 5 (1925) 314.
Nauclea purpurascens Korth. in Ridl., Fl. 2 (1923) 9.

Common in Malaya along rocky streams. Recorded from limestone at and around Gua Musang, Kelantan, by stream banks.

Oldenlandia ovatifolia (Cav.) DC., Prodr., 4 (1830) 427; Craib, Fl. Siam 2 (1932) 57; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 50.
O. nudicaulis Roth., in Ridl., Fl. 2 (1923) 53.

Rare in Malaya, only from the extreme North-west, including Langkawi.

According to Henderson, also from limestone there. I have not seen any specimens of this species which is very similar to *O. rosettifolia.*

Oldenlandia pterita (Bl.) Miq., Fl. Ind. Bat. 2 (1857) 193; Craib, Fl. Siam 2 (1932) 57; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 50.
O. alata Roxb. (non Koen.), in Ridl., Fl. 2 (1923) 53.

Oldenlandia rosettifolia Geddes, Kew Bull. (1928) 242; Craib, Fl. Siam 2 (1932) 58; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 60.

Small herb. Stem 2.5-5 cm or more long. Leaves, in one or more pseudowhorls of 2 pairs of opposite leaves arising very close together, elliptic or oblong, thin, 1-4 by 0.6-1.5 cm, sometimes larger. Inflorescence terminal, slender and lax, 5-7 cm or more long. Flowers small, white; corolla-tube 0.05 cm long, lobes 4, 0.2 cm long. Stamens 4, anthers just over 0.1 cm long. Fruits 2-loculate, 0.25 cm long and slightly broader, top truncate.

Distributed in Thailand, from limestone but not restricted to it. In Malaya, only from Langkawi and so far known, confined to limestone.

Ophiorrhiza communis Ridl., J. Str. Br. R. As. Soc. 61 (1912) 16, Fl. 2 (1923) 39; Craib, Fl. Siam 2 (1932) 63; Henders., Mal. Wild Fls. Dicots. (1959) 208.

Ophiorrhiza discolor R. Br. ex Don, Gen. Syst. 3 (1834) 522; Ridl., Fl. 2 (1923) 36; Craib, Fl. Siam 2 (1932) 64; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 50, Mal. Wild Fls. Dicots. (1959) 209.

A plant of rocky places, not common in Malaya, except on the Selangor limestone. The stem and leaves turn a characteristic pink when dried.

Ophiorrhiza fruticosa Ridl., Fl. 2 (1923) 41; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 50.
O. fruticulosa Ridl., J. Str. Br. R. As. Soc. 61 (1912) 15; non Nadeaud.

Herb. Leaves lanceolate-acuminate, finely pubescent above, 3.5-6.5 by 2-3.5 cm. Peduncle pubescent, 1.2 cm long; terminal. Flowers 0.3 cm long. Capsule laterally oblong, subreniform.

Endemic to limestone in Selangor, rare. Known only from 3 records, Bukit Takun, *(Nur 34374);* Gua Batu *(Ng FRI 1639, Ridley 8237).*

Ophiorrhiza hispidula Wall. ex Don., Gen. Syst. 3 (1834) 523; Ridl., Fl. 2 (1923) 40; Craib, Fl. Siam 2 (1932) 64; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 50.

Ophiorrhiza kunstleri King, Mats. 14 (1904) 176; Ridl., Fl. 2 (1923) 41; Craib, Fl. Siam 2 (1932) 66; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 50.

Herb, unbranched, 15-30 cm tall, shortly pubescent all over. Leaves membranous, elliptic or ovate-elliptic; lateral veins slender, 12-20 pairs; 7-12 by 3-6 cm. Stipules lanceolate, 0.5-0.8 cm long. Inflorescence terminal, 3-6 cm long; peduncle 2-4 cm long. Capsule obreniform, 0.5 cm across.

Distributed in Phuket, Peninsular Thailand. Restricted to limestone in Malaya, and recorded from Kelantan, Langkawi and Perlis; not rare.

Ophiorrhiza longerepens Ridl., Kew Bull. (1929) 258; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 50.

Herb, prostrate and ascending; stem slender, 10-25 cm long, puberulous. Leaves subcoriaceous, ovate, ovate-elliptic to elliptic, glabrescent on the nerves, 1.5-3 by 0.8-1.5 cm. Inflorescence terminal or axillary, peduncle 1-2 cm long. Corolla tube 0.5 cm long, white. Capsule 0.2 cm long and 0.5-0.7 cm wide.

Endemic, known only from limestone around Gua Musang, where it is common. A slender herb often seen creeping over mossy rocks in shade.

Ophiorrhiza pallidula Ridl., Fl. 2 (1923) 38; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 50.

Endemic, not common, in lowland forest, sometimes on limestone.

Ophiorrhiza remotiflora Ridl., J.F.M.S. Mus. 10 (1920) 140; Fl. 2 (1923) 37; Craib, Fl. Siam 2 (1932) 68.
O. major Ridl., Fl. 2 (1923) 36.

Paederia tomentosa Bl., Bijdr. (1826) 968; King, Mats. 15 (1904) 97; Ridl., Fl. 2 (1923) 174; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 50.

Pavetta indica Linn., Sp. Pl. (1753) 110; Hk.f., F.B.I. 3 (1880) 150; Ridl., Fl. 2 (1923) 100; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 50.

Pavetta naucleiflora R. Br. ex G. Don Gen. Syst. 3 (1834) 575; Ridl., Fl. 2 (1923) 101; *p.p.* Craib, Fl. Siam 2 (1934) 168.

Pavetta pauciflora Ridl., Fl. 2 (1923) 101; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 50.

Small tree. Leaves thin, elliptic-lanceolate, long acuminate, base long, narrowed, 10-15 by 1.2-3.8 cm. Petioles 1.2 cm long. Inflorescence terminal, very lax, to 7 cm long. Calyx-tube subglobose, with 4 short lobes. Corolla tube white, 1.2 cm long, lobes 4, oblong. Stamens 8. Fruit globose.

Endemic and known only from Ridley's collections from Gua Batu, Selangor *Ridley* s.n. 13th Dec. 1920, Dec. 1920 and Dec. 1927).

Petunga hirta Ridl., J. Mal. Br. R. As. Soc. 1 (1923) 69; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 51.

Prismatomeris malayana Ridl., J.F.M.S. Mus. 10 (1920) 142, Fl. 2 (1923) 116; Craib, Fl. Siam 2 (1934) 183; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 51.
P. albidiflora K. et G. Mats. 15 (1904) 90.

Psychotria angulata Korth., Ned. Kruidk. Arch. 2 (1851) 243; Ridl., Fl. 2 (1923) 138; Craib, Fl. Siam 2 (1934) 189; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 51.
P. griffithii Hk. f. var. *angustifolia* Ridl., l.c. 137.

Psychotria cantleyi Ridl., J. Str. Br. R. As. Soc. 61 (1912) 24, Fl. 2 (1923) 130; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 51.

Endemic, not common; recorded from limestone on Gua Batu, Selangor and doubtfully from Kota Glanggi, Pahang.

Psychotria montana Bl., Bijdr. (1826) 960; Ridl., Fl. 2 (1923) 137; Craib, Fl. Siam 2 (1934) 198; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 51.

Psychotria rhinocerotis Reinw. ex Bl., Bijdr. (1826) 961; Ridl., Fl. 2 (1923) 135; Craib, Fl. Siam 2 (1934) 198; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 51.

Psychotria rostrata Bl., Bijdr. (1826) 961; Ridl., Fl. 2 (1923) 134; Craib, Fl. Siam 2 (1934) 197; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 51.

Psychotria sarmentosa Bl., Bijdr. (1826) 964; Ridl., Fl. 2 (1923) 131; Craib, Fl. Siam 2 (1934) 198.

Psychotria viridiflora Reinw. ex Bl., Bijdr. (1826); Ridl., Fl. (1923) 139; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 51; Back. & Bakh. f., Fl. Java 2 (1965) 332.

Randia densiflora (Wall.) Benth., Fl. Hongk. (1861) 155; (including var. *parvifolia*), King, Mats. 14 (1904) 208; Ridl., Fl. 2 (1923) 75; Corner, Gard. Bull. S.S. 10 (1938) 50.
R. cochinchinensis (Lour.) Merrill, Trans. Am. Phil. Soc. 24 (1935) 365; Back. & Bakh. f., Fl. Java 2 (1965) 312.
R. oppositifolia Koords., in Henders., J. Mal. Br. R. As. Soc. 17 (1939) 51.

Distributed all over tropical Asia, from India to China and Japan, to Micronesia and to Australia. A variable species, common in Malaya in lowland forest and on limestone.

Merrill proposed the name *R. cochinchinensis* (Lour.) Merr. for the species on the grounds that it was *Aidia cochinchinensis* Lour. (Comm. Lour. Fl. Cochinch. (1935) 365). This is adopted by Backer and Bakhuizen f. l.c. 312. Corner, however, l.c. 50 has given sufficient reasons to effectively dismiss this name.

King l.c. 209 created a var. *parvifolia* giving the distinguishing characters as "leaves narrowly oblong-elliptic, 3-5 in. long and 1.25 to 2.75 in. broad; petioles 0.15 to 0.2 in., Ridley in his Flora, l.c. 76, added on to this writing, "Calyx very pubescent. Corolla lobes white, silky outside".

This variety however is not as easily spotted as defined; there are specimens with narrowly oblong-elliptic leaves, but these only form the end of a range from the ones with broader leaves; there are also such specimens with non pubescent calyx and corolla-lobes. The degree of pubescence varies but independently of the leaf shape; in fact flower size is also variable; and not even the colour is constant. On

the label of *Kiah 35275* it is stated that the flowers are pale yellow (instead of the usual cream or white). Based on King and Ridley's concept of a variety *parvifolia*, it has not been possible to identify consistently a variety as such. Therefore, I have ignored such a variety; certainly this variable species needs detailed study.

Tarenna angustifolia (King) Merr., Philip. J. Sc. 17 (1921) 472; Craib, Fl. Siam 2 (1932) 88.
Stylocoryna angustifolia King, Mats. 14 (1904) 199; Ridl., Fl. 2 (1923) 109.

Shrub to 2 m. Leaves coriaceous, narrow, oblong-lanceolate, glabrous, 6-9 by 1.8-2.4 cm. Inflorescence terminal, to 2 cm across. Flowers 0.8 cm long, greenish-white, calyx campanulate, lobes linear lanceolate; corolla short, not exceeding the calyx; anthers 5, connate.

Distributed in Peninsular Thailand. In Malaya, known only from limestone in Perak.

Tarenna appressa (King) Corner, Gard. Bull. S.S. 10 (1938) 51.
Stylocoryne appressa King, Mats., 14 (1904) 200.
Tarenna papillosa Ridl., Fl. 2 (1923) 103.

Endemic and common in lowland forest; once from limestone. (Dayang Bunting, Langkawi, *Stone 6932*).

Tarenna calcarea Ridl., Fl. 2 (1923) 108; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 51.

Shrub. Branches white. Leaves membranous, ovate-cuspidate, 10-12.5 by 5-7.5 cm. Inflorescence terminal, lax and few-flowered, about 4 cm long. Calyx very small with 5 short acute points; corolla-tube 0.3 cm long, lobes, oblong, blunt, nearly as long; anthers as long as the lobes.

Endemic and known only from limestone in Perak. Very rare.

Tarenna curtisii (King) Ridl., Fl. 2 (1923) 107; *p.p.;* Craib, Fl. Siam 2 (1932) 90; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 51.
Webera curtisii King, Mats. 15 (1904) 67. *p.p.*

Shrub, 1-3 m tall. Leaves coriaceous or subcoriaceous, elliptic, elliptic-lanceolate or elliptic-obovate, drying dark olivaceous-brown or purplish-black, glabrous, (2.5-) 5-9 by (1-) 1.5-3.5 cm. Inflorescence terminal, to 2 cm long, buds and branches densely subhirsute. Calyx with ovate-acuminate lobes each about 0.3 cm long. Corolla-tube about as long as the calyx; lobes to 0.9 cm long, white. Fruit globose or subglobose, crowned by the persistent calyx, 0.6-0.8 cm across, 2-loculate with 1-3 seeds in each locule.

Distributed in peninsular Thailand. A common shrub on Malayan limestone. Craib believes that in the original description of this species, collections representing two distinct species were included; *Curtis 2545* is probably a small-leaved form of *T. adangensis* Ridl.

Ridley, l.c. 107, mentioned a variety of this species characterized by very small leaves and more compact habit, found on Gua Batu, Selangor. Later, Henderson l.c. 51, added that this variety has also been found on Gua Tipus, Pahang and

suggested that this may be a distinct species. However, after seeing numerous plants of this species growing in various niches on the limestone and examining all the herbarium material available to me, I feel that there is a range of leaf sizes and habit of growth. I therefore propose that the variety suggested by both Ridley and Henderson does not exist.

Generally plants growing on dry rocky exposed summits with hardly and accumulation of soil or humus tend to be stunted and compact and thus produce smaller leaves. Those from hill slopes with fairly deep soil (where there will invariably be a cover of shrubs and small trees) grow under partial shade and exhibit a less restrained manner of growth and will produce larger leaves.

Restricted to limestone.

Tarenna pulchra Ridl., Fl. 2 (1923) 104.
Webera pulchra Ridl., J.F.M.S. Mus. 4 (1909) 33.

Endemic, usually by streams in hill forest, uncommon. Recorded from limestone in Kelantan.

Tarenna ridleyi (Pears.) Ridl., Fl. 2 (1923) 106; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 52.
Webera ridleyi Pears., in King, Mats. 15 (1904) 66.

Endemic, recorded from Singapore, Johore, Pahang and Perak (Gunong Runto, *Henderson 23827).*

Timonius atropurpureus Craib, Fl. Siam 2 (1932) 132; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 52.
T. hirsutus Ridl. Fl. 2 (1923) 115.

Shrub, 2-3 m tall, twigs slender, purple-brown, young parts pubescent. Leaves thin, upper surface glabrescent; lower, more or less sparsely pubescent all over, the hairs denser and longer (to 0.2 cm) on the veins, 3-8 (-10) by 1-2.5 (-3) cm. Stipules ovate-acuminate, 0.3-0.7 cm long. Inflorescence cymose, peduncles 1.5-2.5 cm long, auxillary, male, few flowered; female, solitary. Calyx tube short, lobes to 0.2 cm long, linear. Corolla-tube to 0.6 cm long, lobes 4, small. Fruit oblong, 0.7-1 cm long, bluntly angled; glabrescent.

Distributed in southern Thailand. In Malaya, except for a solitary record from Perak, confined to Langkawi and probably restricted to limestone; not uncommon.

Urophyllum corymbosum Korth., Ned. Kruidk. Arch. 2 (1851) 194; Ridl., Fl. 2 (1923) 67.
U. macrophyllum (Bl.) Korth., in Back. & Bakh. f. Fl. Java 2 (1965) 306.

Urophyllum glabrum Wall., in Roxb., Fl. Ind. 2 (1824) 186; Ridl., Fl. 2 (1923) 68; Henders., Mal. Wild Fls. Dicots (1959) 215.

RUTACEAE

1. Climbers with recurved spines 2
   Shrubs or trees, never climbing 3

2. Leaves simple ..... *Paramignya scandens*
Leaves trifoliolate ..... *Luvunga eleutherandra*

3. Leaves, all simple 4
Leaves with 3 or more leaflets; sometimes some leaves simple 7

4. Ovary with 3-5 locules; fruit small: 1-2 cm across 5
Ovary with 8-15 locules; fruit large: usually more than 5 cm across 6

5. Leaves retuse. Calyx with 2 irregular lobes. Coastal ..... *Atalantia monophylla*
Leaves not retuse, tip acute or blunt. Calyx with 4 lobes. Inland ..... *Atalantia roxburghiana*

6. Petioles broadly winged, 2-5 cm wide, distinctly articulated with the blade. Fruit surface smooth ..... *Citrus macroptera*
Petioles not or only narrowly winged, not distinctly articulated with the blade. Fruit surface usually uneven and bumpy ..... *Citrus medical*

7. Buds and inflorescence stalk with rust-coloured pubescence. Ovary with 2-5 locules, each with one ovule 8
Buds and inflorescence stalk not with rust-coloured pubescence. Locules of ovary with 2 or more ovules each 12

8. Ovary rusty pubescent 9
Ovary not rusty pubescent, usually glabrous 10

9. Leaflets 1 or 3 ..... *Glycosmis puberula*
Leaflets 5-7 ..... *Glycosmis sapindoides*

10. Leaves elliptic-lanceolate, apices acute, often acuminate 11
Leaves broadly elliptic to orbicular, apices rounded, usually notched ..... *Glycosmic calcicola*

11. Leaflets 3, secondary nerves 4-5 pairs ..... *Glycosmis rupestris*
Leaflets 4-7, secondary nerves 5-8 pairs ..... *Glycosmic chlorosperma*

12. Petals 4, stamens 8 13
Petals 5,, stamens 10 14

12. Leaflets 6-7. Very rare, doubtfully recorded once from Malaya ..... *Clausena harmandiana*
Leaflets 9-30. Common. ..... *Clausena excavata*

14. Flowers numerous, in clusters; crushed leaves faintly to strongly spicy or pungent 15
Flowers solitary or few together; crushed leaves very faintly smelling of lime *Murraya paniculata*

15. Leaflets 3-11, large: 3-17 by 2-5 cm ..... *Micromelum minutum*
Leaflets 9-23, small: 2-5 by 0.6-2.5 cm ..... *Murraya koenigii*

Atalantia monophylla D.C., Prodr. 1 (1824) 535; Swingle, Citrus Ind. 1 (1967) 316; Stone, Tree Fl. Mal. 1 (1972) 373.
A. spinosa (Willd.) Tan., in Henders., J. Mal. Br. R. As. Soc. 17 (1939) 39; Corner, Ways. Trees 1 (1952) 567.

Atalantia roxburghiana Hk.f., F.B.I. 1 (1875) 515; Swingle, Citrus Ind. 1 (1967) 322; Stone, Tree Fl. Mal. 1 (1972) 373.
A. kwangtungensis Merr. sensu Henders., J. Mal. Br. R. As. Soc. 17 (1939) 39, and possibly also sensu Merr.
Possibly endemic, in open country and on limestone.

Citrus macroptera Montr., Mem. Acad. Sci. Lyon 10 (1860) 187; Swingle, Citrus Ind. 1 (1967) 395; Stone, Tree Fl. Mal. 1 (1972) 374.

Clausena excavata Burm. f., Fl. Ind. (1768) 87; Ridl., Fl. 1 (1922) 352; Swingle, Citrus Ind. 1 (1967) 212; Stone, Tree Fl. Mal. 1 (1972) 375.

Glycosmis calcicola Stone, Gard. Bull S. 26 (1972) 55, Tree Fl. Mal. 1 (1972) 381.
G. parkinsonii Tan. var. *ovatofoliolis* Tan., in Henders., J. Mal. Br. R. As. Soc. 17 (1939) 39.

Shrub, 1-3 m tall. Leaflets (1-) 3-5 (-7), broadly elliptic, ovate to orbicular, 2-6 by 1.4-3.5 cm. Young twigs, petioles and petiolules usually finely pubescent. Flowers few, in short axillary racemens. Fruits ripen red to dark blue/purple, oviod, to nearly 1 cm long.

Endemic to limestone and widely distributed, common, often on dry craggy summits.

var. **kelantanica** Stone l.c. 57.

This has larger leaves. So far only recorded from limestone in Kelantan.

Glycosmis chlorosperma (B1.) Spreng., Syst. Veg. 4 (1827) 162; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 39; Stone, Tree F1. Mal. 1 (1972) 382.
G. malayana Ridl., Fl. 1 (1922) 350.

Glycosmis puberula Lindl., in Wall. Cat. (1832) 6375; Ridl., Fl. 1 (1922) 351; Stone, Tree Fl. Mal. 1 (1972) 381.

Glycosmis rupestris Ridl., J. Str. Br. R. As. Soc. 59 (1911) 81; Fl. 1 (1922) 350; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 39.

Glycosmis sapindoides Lindl. ex Wall., Cat. (1832) 6376; Hk. f., F.B.I. 1 (1875) 501; Ridl., Fl. 1 (1922) 351; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 39; Stone, Tree Fl. Mal. 1 (1972) 381.

Endemic, uncommon; once recorded from limestone.

Luvunga eleutherandra Dalz., in Hooker, J. Bot. Kew Gard. Misc. 2 (1850) 258; Ridl., Fl. 1 (1922) 355; Swingle, Citrus Ind. 1 (1967) 267; Stone, Tree Fl. Mal. 1 (1972) 369.

Micromelium minutum (Forst.) Wt. & Arn., Prodr. F1. Pen. Ind. Or. 1 (1834) 94; Swingle, Citrus Ind. 1 (1967) 203; Stone, Tree Fl. Mal. 1 (1972) 383.
M. pubescens B1., in Ridl., Fl. 1 (1922) 352; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 39.

Murraya koenigii (L.) Spr., Syst. Veg. 2 (1825) 315; Swingle, Citrus Ind. 1 (1967) 237; Stone, Tree Fl. Mal. 1 (1972) 385.

Recorded once from limestone, doubtfully wild (Batu Ayam, Langkawi, *Henderson 28947).*

Murraya paniculata (L.) Jack, Malay Misc. 1 (1820) 31; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 39; Swingle, Citrus Ind. 1 (1967) 231; Stone, M.N.J. 24 (1971) 93, Tree Fl. Mal. 1 (1967) 384.
M. exotica L., in Ridl., Fl. 1 (1922) 353.

Shrub or small tree, 2-5 m tall. Leaves with 3-7 leaflets. Leaflets elliptic or elliptic-ovate, tapered at both ends. Flowers solitary or few in axillary or terminal cymes. Fruit an ovoid berry.

Distributed in India, China and southwards to Australia. In Malaya, it is common on the limestone hills of Perak and Kelantan; rightly stated as 'wild on limestone hills ...' by Ridley l.c. Its presence on the limestone has been doubted, with reason, by Henderson l.c., as strangely no specimens from limestone were collected prior to 1961. This species is also widely cultivated.

Paramignya scandens (Griff.) Craib subsp. *ridleyi* (Burkill) Swingle, J. Wash. Acad. Sci. 28 (1930) 533, Citrus Ind. 1 (1967) 273; Stone, Tree Fl. Mal. 1 (1972) 384.
P. griffithii Ridl., Fl. 1 (1922) 356.

Endemic and rare; known only from Singapore and Malacca. Recently from limestone on Gua Batu, Selangor (Stone 8981).

Dubious records

Citrus medica L., Sp. Pl. (1753) 782; Ridl., Fl. 1: 1922) 358; Swingle, Citrus Ind. 1 (1967) 370; Stone, Tree Fl. Mal. 1 (1972) 375.

Doubtfully wild in Malaya. One specimen was collected from near limestone; doubtfully on limestone and probably cultivated (Batu Pinta, Bertam, Kelantan, *UNESCO 1017*).

Clausena harmandiana (Pierre) Guill., Not. Syst. 1 (1910) 219; Swingle, Citrus Ind. 1 (1967) 222.

A small tree, distributed in Cambodia and Laos. Doubtfully recorded from Malaya. The specimen, *Henderson 23820* in Singapore identified as such probably has the wrong locality or may have the wrong label attached.

SANTALACEAE

Scleropyrum wallichianum Arn., Jard. Mag. Zool. & Bot. 2 (1858) 550.
Scleropyrum sp., Henders., J. Mal. Br. R. As. Soc. 17 (1939) 68.

Tree, spiny. Leaves elliptic-ovate or oblong, coriaceous, 8-15 by 3-7 cm; 3-nerved at the base. Racemes 2-5 cm long, spicate; perianth 0.2-0.3 cm across. Fruit, pyriform, 2.5 cm long, crowned by the persistent perianth.

Distributed in India and in Ceylon, usually in the highlands to 2000 m. Recorded from limestone in Kedah at a low altitude. This is apparently the only record of the species outside India and Ceylon; this locality is about 2400 km to the East of Ceylon but at roughly the same latitude.

SAPINDACEAE

1. Leaves trifoliolate or odd-pinnate 2
   Leaves even-pinnate 4

2. Leaves trifoliolate 3
   Leaves odd-pinnate ..... *Paranephelium macrophyllum*

3. Leaves subcoriaceous, glabrous ..... *Allophylus cobbe* var. *glaber*
   Leaves thin, pubescent ..... *Allophylus cobbe* var. *villosus*

4. Inflorescence large, terminal, 8-40 cm long ..... *Dimocarpus longan* ssp. *longan* var. *longan*
   Inflorescence small, axillary, 2.5-5 cm long ..... *Xerospermum wallichii*

Allophylus cobbe (L.) Raeusch., Nomencl. ed. 3 (1797) 108; Corner, Gard. Bull. S.S. (1938) 40; Leenh; Blumea 15 (1967) 322.

A very variable species which, when taken in a broad sense, is distributed over most of the tropics and subtropics.

var. glaber Corner, l.c. 40.

Leaves subcoriaceous glabrous.

Widely distributed in lowland forest in Malaya, sometimes on limestone.

var. *villosus* Corner, l.c. 42.

Leaves thin, more or less hispid-velvety. Widely distributed in lowland forest in Malaya, recorded on limestone from Kedah and Perlis. Apart from having thinner pubescent leaves this is identical to var. *glaber;* degree of pubescence varies and transitions to var. *glaber* appear commonly.

Dimocarpus longan Lour., Fl. Coch. (1790) 233; Leenh., Blumea 19 (1971) 122.
Nephelium echinulatum Ridl., Fl. 1 (1922) 503.
N. malaiense Griff., in Corner, Ways. Trees 1 (1952) 592.
N. setosum Ridl., Fl. 1 (1922) 503.

ssp. **longan** Leenh., l.c. 126.

var. **longan** Leenh. l.c. 126. As *Nephelium ?mutabile* Bl., in Henders., J. Mal. Br. R. As. Soc. 17 (1939) 42.

Tree. Leaves even-pinnate, leaflets (2-) 4-5 pairs; chartaceous to coriaceous, glabrous above, subglabrous below, elliptic, ovate-eliptic or ovate-lanceolate, 3-19 by 1.5-6.5 cm. Inflorescence terminal, 8-40 cm long; flowers yellowish brown, petals reduced, shorter than the calyx. Fruits subglobular, 1.2-1.5 cm across, usually warty.

Distributed in Ceylon, India, Burma, Thailand, China, Taiwan and southwards to Borneo, Java. Philippines, and New Guinea. Widely cultivated; it is difficult to draw the limits of the area of natural distribution. Recorded from limestone on Gunong Pondok; the only record of this subspecies from Malaya *(Henderson 23812).*

Paranephelium macrophyllum King, Mats. 8 (1896), 450; Ridl., Fl. 1 (1922) 509; Corner, Ways. Trees 1 (1952) 594.

Xerospermum wallichii King, Mats. 8 (1896) 432; Ridl., Fl. 1 (1922) 498; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 42.

Endemic, not common in lowland and hill forest. According to Henderson l.c., recorded from limestone at the base of Gunong Baling, Kedah.

SAPOTACEAE

1. Leaves glabrous when mature 2
   Leaves velvety or densely woolly when mature 8
2. Leaves glaucous below; more than 15 cm long, obovate ..... *Palaquium obovatum*
   Leaves not glaucous below 3
3. Leaves densely clustered; twigs very stout, 0.8-2.0 cm across ..... *Madhuca ridleyi*
   Leaves spaced or loosely clustered; twigs not as stout 4
4. Base of leaves tapered; young leaves and twigs and leaves scurfy ..... *Planchonella obovata*
   Base of leaves cuneate or rounded 5
5. Base of leaves rounded, margin upcurled, wavy ..... *Mimusops elengi*
   Base of leaves cuneate, margin different 6
6. Apex of leaves acuminate, blade thinly coriaceous to coriaceous 7
   Apex rounded ..... *Isonandra perakensis* var. *kelantanensis*
7. Twigs scurfy when young; leaves oblong. Flowers not crowded in pseudoterminal heads ..... *Payena lucida*
   Twigs glabrous; leaves elliptic to obovate. Flowers crowded in pseudoterminal heads. Only Dayang Bunting, Langkawi ..... *Madhuca calcicola*
8. Leaves densely woolly below ..... *Palaquim ottolanderi*
   Leaves velvety below 9
9. Leaves coriaceous, margin recurved, base rounded or slightly acuminate. All leaves velvety below ..... *Isonandra perakensis* var. *perakensis*
   Leaves thinly coriaceous, margin not recurved, base acuminate. Some older leaves glabrous below ..... *Planchonella obovata*

Isonandra perakensis K. & G., J.As. Soc. Beng 74 (1906) 166; Ridl., Fl. 2 (1923) 261; Henders., J . Mal. Br. R. As. Soc. 17 (1939) 54; Jeuken, Blumea 6 (1952) 577; Ng, Tree Fl. Mal. 1 (1972) 400.

var. **kelantanensis** Ng., Gard. Bull. S. 24 (1969) 7, Tree Fl. Mal. 1 (1972) 400.

Small tree, 5-10 m tall. Leaves spiral, loosely clustered, broadly elliptic-ovate or broadly elliptic, 3.5-6 by 2.5-4 cm. Flowers 1-2 in axils of leaves, sepals 5, corolla 4-lobed. Fruits and seeds unknown.

Endemic. Known only from Gua Jaya and Gua Panjang, Kelantan and Gua Peningat, Pahang. According to Ng l.c., possibly a new species, but more material is needed.

var. **perakensis,** Ng, Tree Fl. Mal. 1 (1972) 400.

Small tree, 5-10 m tall. Leaves spiral, loosely clustered, 4-13 by 2-6 cm, elliptic, occasionally elliptic-obovate, lower surface velvety. Flowers in the axils of upper leaves, to 16.

Recorded only from the limestone in Perak, endemic.

Madhuca calcicola van Royen, Blumea 10 (1960) 96; Ng, Tree Fl. Mal. 1 (1972) 405.

Small tree. Leaves loosely clustered, 5-18 by 2-7 cm, elliptic to obovate, glabrous. Apex acute to acuminate, base acute. Flowers axillary, sepals 4, corolla 10 lobes; stamens 20; ovary glabrous. Fruits unknown.

Endemic and known only from the limestone at Pulau Dayang Bunting, Langkawi.

Madhuca ridleyi Lam, Gard. Bull. S.S. 9 (1935) 105; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 54; Ng, Tree Fl. Mal. 1 (1972) 409.

Small tree, 20-30 m. Twigs stout, 0.8-2 cm across. Leaves very closely clustered at the ends of twigs, 12-25 by 4-11 cm, obovate. Flowers in clusters in leaf axils. Fruits round, to 3 cm across.

Endemic and apparently restricted to limestone except in Perlis where according to Ng l.c., "the species may also be found on low and even seasonally swampy land". On limestone, this species is usually found on day craggy summits, it is uncommon but widely distributed.

Mimusops elengi L., Sp. Pl. (1753) 349; Ridl., Fl. 2 (1923) 278; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 54; Ng, Tree Fl. Mal. 1 (1972) 414.

In Malaya, cultivated throughout, wild in Perlis, Langkawi, and northern Kedah, on rocky coastal areas and inland forest; not uncommon on limestone in Langkawi.

Palaquium obovatum (Griff.) Engl., Bot. Jahrb. 12 (1890) 511; Ridl., Fl. 2 (1923) 273; Ng. Tree Fl. Mal. 1 (1972) 423.

Palaquium ottolanderi K. et V., Bijdr. Booms. Java 1 (1894) 146; Ng, Tree Fl. Mal. 1 (1972) 424.
P. clarkeanum K. et G. in Rid., Fl. 2 (1923) 274.

Payena lucida (G. Don) DC., Prodr. 8 (1884) 197; Ng, Tree Fl. Mal. 1 (1972) 433.
P. dasyphylla var. *glabrata* K. et G., J. As. Soc. Beng. 74 (1905) 174; Ridl., Fl. 2 (1923) 265.

Planchonella obovata (R. Br.) Pierre, Not. Bot. Sapot. (1890) 36; Ng, Tree Fl. Mal. 1 (1972) 437.
Sideroxylon ferrugineum Hk. et Arn. *in* Ridl., Fl. 2 (1923) 259.

In Malaya, common on rocky and sandy sea coasts throughout and on summits of limestone hills.

SCROPHULARIACEAE

1. Leaves linear, narrowly elliptic or lanceolate 2
   Leaves ovate to broadly ovate 3

2. Corolla tube very short; stamens 4, more or less equal, surrounded by numerous hairs from the corolla ..... *Scoparia dulcis*
   Corolla tube long; stamens 4, didynamous, not surrounded by hairs ..... *Centranthera hispida*

3. Pubescent herb; flowers in dense spherical or ovoid heads ..... *Adenosma capitatum*
   Glabrous herb; flowers in lax racemes ..... *Curanga amara*

Adenosma capitatum Benth. ex Hance, J. Linn. Soc. 13 (1873) 114; Hk. f., F.B.I. 4 (1885) 264; Ridl., Fl. 2 (1923) 474; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 59; Mal. Wild Fls. Dicots. (1959) 330.

Centranthera hispida R. Br., Prodr. (1810) 438; Hk.f., F.B.I. 4 (1885) 301; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 60.

Recorded from Malaya only once, in Langkawi, by Selat Panchor, on limestone *(Henderson 29057)*.

Curanga amara Juss., Ann. Mus. Par. 9 (1807) 320; Hk. f., F.B.I. 4 (1885) 275; Ridl., Fl. 2 (1923) 484; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 60.

Fairly common by rivers and forests in shady places. Recorded once from limestone (Ampang, Perak, *Burkill 13925)*.

Scoparia dulcis L., Sp. (1753) 116; Hk.f., F.B.I. 4 (1885) 289; Ridl., Fl. 2 (1923) 488; Henders., Mal. Wild Fls. Dicots. (1959) 328.

A common weed of open places with one record from limestone in Langkawi, at "sea level, exposed to sea spray" *(Turnau 743)*.

SOLANACEAE

1. Leaves simple, entire or sometimes lobed 2
   Leaves compound; fruit a succulent berry, 1-2 cm across, ripening orange-red ..... *Lycopersicon esculentum* var. *carasiforme*

2. Leaves without spines, glabrous or pubescent 3
   Leaves spiny especially along the veins, densely stellate tomentose ..... *Solanum ferox*

3. Fruits enclosed in the bladder-like enlarged sepals ..... *Physalis minima*
   Fruits not so enclosed, sepals normal 4

4. Flowers solitary or 2-6 together in axillary fascicles 5
   Flowers in inflorescences with a peduncle 2-7 cm long, usually extra-axillary 7

5. Fruits globose 6
   Fruits conical, 1-2 by 0.3-0.7 cm ..... *Capsicum frutescens*

6. Flowers solitary, calyx-lobes 5 ..... *Solanum biflorum*
   Flowers solitary or 2-6 together in fascicles, calyx-lobes 10-11 ..... *Solanum decemdentatum*

7. Leaves glabrous or glabrescent; flowers in a simple umbellate inflorescence; stem without prickles ..... *Solanum nigrum*
   Leaves densely stellate pubescent especially below; flowers in branched corymbose inflorescence; stem prickled, sometimes sparsely ..... *Solanum torvaum*

Physalis minima L., Sp. Pl. (1753) 183; Ridl., Fl. 2 (1923) 470; Henders., Mal. Wild Fls. Dicots. (1959) 325.

A pantropical weed, in waste and cultivated grounds; common in Malaya. Once recorded from limestone at the base of a hill in Perak.

Solanum biflorum Lour., Fl. Cochinch. (1790) 129; Hk.f., F.B.I. 4 (1883) 232; Ridl., Fl. 2 (1923) 467.
Lycianthes biflora (Lour.) Bitt., Abh. Nat. Ver. Bremen 24 (1920) 461; Craib, Fl. Siam 3 (1954) 45; Back. & Bakh. f., Fl. Java 2 (1965) 476.

Shrub. Leaves elliptic or oblong, thin, pubescent or glabrescent; entire, base decurrent, 4-12 by 2-4.5 cm. Flowers axillary, solitary; pedicels 0.6 cm long. Calyx-lobes 0.2 cm long; corolla-lobes lanceolate, slightly longer than the calyx. Fruit globose, glabrous, 0.5-0.8 cm across.

Distributed in S. China and Indochina. Rare in Malaya, known only from limestone or localities close to it; in Kelantan, Pahang and Selangor.

Solanum decemdentatum Roxb., Fl. Ind. 1 (1820) 565; Ridl., Fl. 2 (1923) 466; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 59.

Uncommon in Malaya, usually in rocky places in the North. According to Henderson l.c. recorded from limestone on Gunong Senyum, Pahang.

Solanum ferox L., Sp. Pl. (ed. 2) 2 (1763) 267; Hk.f., F.B.I. 4 (1883) 233; Ridl., Fl. 2 (1923) 467; Burk., Dict. Econ. Prod. Mal. (2nd impr.) 2 (1966) 2079.

Distributed in Ceylon, India, throughout SE. Asia and Malesia. Fairly common in Malaya in waste-ground; said to have been brought into Malaya from Java (Ridley l.c.). Sometimes cultivated, as the fruits are used as a sour-relish (chiefly by the Indians) and various parts of the plant are used in Malay medicine (Burkill, l.c.). Recorded *(Stone 9497)* from the summit of Gua Musang (1970), as a secondary element found 12 months after fire destroyed the original vegetation. According to the collector, the species was also seen at the base of the hill in railwaymen's living quarters. He also suggested that this was the probable source of the plant on the summit. This must be the case as the species is very likely endo-ornithochorous (eaten and dispersed by birds after seeds have passed through their digestive tracts).

Solanum nigrum L., Sp. Pl. (1753) 186; Ridl., Fl. 2 (1923) 465; Craib, Fl. Siam 2 (1954) 40; Henders., Mal. Wild Fls. Dicots. (1959) 323.

Distributed throughout the tropical and temperate regions. Common in waste ground in Malaya, once collected from limestone (Perak, *Burkill 13939*)

Solanum torvum Sw., Prodr. (1788) 47; Ridl., Fl. 2 (1923) 468; Craib, Fl. Siam 2 (1954) 43; Henders., Mal. Wild Fls. Dicots. (1959) 324.

Pantropical. Common in Malaya, in waste ground and villages, often cultivated for its edible fruits. Recorded from limestone on the slopes of Gunong Pondok *(Chin 867),* most probably as an escape from nearby villages.

Note

Lycopersicon esculentum Mill., (the tomato), probably the var. *cerasiforme* (Dun.) Alef. (Cherry Tomato, with fruits 1-2 cm in diameter) and *Capsicum frutescens* Linn. (Bird Chilli, with erect, conical fruits 1-3 cm long) have been recorded as escapes from cultivation on hill bases. Both these plants are frequently cultivated and are taken by birds which probably spread them in their droppings.

STAPHYLEACEAE

Turpinia ovalifolia Elmer, Leafl. Philip. Bot. 2 (1908) 490; Lind., Fl. Mal. I, 6 (1960) 58.
T. trifoliata Ridl., Fl. 1 (1922) 511.

Rare in Malaya in lowland forest. Once from limestone on Gua Panjang, Kelantan *(UNESCO 683)*.

STERCULIACEAE

1. Leaves ovate-cordate or broadly ovate, palmately veined at the base 2
   Leaves elliptic, oblong, obovate or lanceolate, pinnately veined; basal pair of veins sometimes to ⅓ or ½ the blade 4

2. Leaf margin entire; sometimes lobed 3
   Leaf margin serrated ..... *Melochia umbellata*

3. Petiole not or only weakly kneed at both ends; flowers tubular, bright orange, scurfy; fruit wall thin, coriaceous ..... *Firmiana malayana*
   Petiole kneed at both ends; flowers small, greenish; fruits of woody pods ..... *Ptergota alata*

4. Basal pair of nerves reaching ⅓ to ½ the length of leaves; a shrub 5
   Not so; nearly always a tree 6

5. Leaves equal-sided ..... *Helicteres angustifolia*
   Leaves unequal-sided ..... *Helicteres hirsuta*

6. Lower surface of leaves glabrous or sparsely pubescent 7
   Lower surface of leaves densely covered by adpressed stellate scales or erect stellate hairs 8

7. Flowers in short axillary cymes, cymes less than 0.5 cm long ..... *Leptonychia glabra*
   Flowers in panicles 2-4 cm long, produced after fall of leaves. Only from Langkawi ..... *Sterculia lancaviensis*

8. Pubescence of adpressed stellate scales and/or hairs 9
   Pubescence of erect stellate hairs 12

9. Coastal tree, ... 10
   Inland forest trees 11

10. Leaves 5.5-10 cm long, chartaceous; fruits with five very prominent ridges ..... *Pterospermum pectiniforme*
    Leaves (7-)10-25 cm long, coriaceous; fruits with a keel on one side ..... *Heritiera littoralis*

11. Leaves with distinctly cordate or subcordate base, lower surface with adpressed scales ..... *Heritiera pterospermoides*
    Leaves with obtuse or rounded base, lower surface with adpressed stellate hairs ..... *Pterospermum jackianum*

12. Calyx 5-cleft to the middle ..... *Sterculia angustifolia*
    Calyx 5-cleft almost to the base ..... *Sterculia rubiginosa*

Firmiana malayana Kosterm., Reinw. 5 (1961) 384; Kochumm., Tree Fl. Mal. 2 (1973) 357.
F. colorata Roxb., in Kosterm., Reinw. 4 (1957) 285.
F. fulgens (Wall. ex King) Corner, Ways. Trees 1 (1922) 610.
Erythropsis fulgens (Wall. ex Mast.) Ridl., Fl. 1 (1922) 277.

Fairly common in Malaya in the northern half, in lowland forest, sometimes cultivated. A sterile specimen from Bukit Chintamani, Pahang, *(Chin 557)* is doubtfully this. However, I have seen this species in flower on the lower slopes of Bukit Takun, Selangor.

Helicteres angustifolia L., Sp. Pl. (1753) 963; Ridl., Fl. 1 (1922) 282; Back. & Bakh. f., Fl. Java 1 (1963) 410.
H. lanceolata DC., in Henders., J. Mal. Br. R. As. Soc. 17 (1939) 37.

Helicteres hirsuta Lour., Fl. Cochinch. (1970) 530; Ridl., Fl. 1 (1922) 281; Corner, Ways. Trees 1 (1952) 611.

Heritiera littoralis Aiton, Hort. Kew Inst. ed. 3 (1789) 546; Ridl., Fl. 1 (1922) 279; Kosterm., Reinw. 4 (1959) 473; Kochumm., Tree Fl. Mal. 2 (1973) 361.

Common on sandy and rocky shores and in mangrove swamps; the fruits are dispersed by water. Recorded from coastal limestone in Langkawi.

Heritiera pterospermoides Kosterm., Reinw. 4 (1959) 506; Kochumm., Tree Fl. Mal. 2 (1973) 363.

Tree to 20 m. Twigs, lower surface of leaves and inflorescence covered with adpressed scales. Stipules lanceolate to 1 cm long, caducous. Leaves elliptic-oblong to oblong-obovate, base subcordate, firm chartaceous to subcoriaceous, 8-20 by 3-9 cm; petioles 0.5-1 cm. Panicles axillary to 6 cm long; perianth urceolate, to 0.5 cm long, 4-5 lobed. Fruits unknown.

Distributed in Sumatra (known from one collection). In Malaya, restricted to limestone; there are several known records. Recent explorations have shown that this is not a rare tree on the Perak limestone. It is usually found in places with fair accumulation of soil; young trees have larger leaves and the petiole may reach 2 cm in length.

Leptonychia glabra Turcz., Bull. Soc. Nat. Mosc. 31 (1858) 222; Ridl., Fl. 1 (1922) 289; Kochumm., Tree Fl. Mal. 2 (1973) 365.

Melochia umbellata (Houtt.) Stapf, Kew Bull. (1913) 317; Back. & Bakh. f., Fl. Java 1 (1963) 405; Kochumm., Tree Fl. Mal. 2 (1973) 366.
M. velutina Wall. ex Bedd., in Ridl., Fl. 1 (1922) 285.

Pterospermum jackianum Wall. ex Masters, in Hk.f., F.B.I. 1 (1874) 367; Ridl., Fl. 1 (1922) 283; Kochumm., Tree Fl. Mal. 2 (1973) 369.

Pterospermum pectiniforme Kosterm., Reinw. 6 (1962) 296.

Distributed in Thailand. Known in Malaya only from Langkawi. Recorded from coastal limestone on Pulau Timun, Langkawi, *(Stone 9134 & 10993)*.

Pterygota alata (Roxb.) R. Br., in Benn., Pl. Jav. Rar. 2 (1844) 234; Kosterm., Reinw. 2 (1953) 365; Kochumm., Tree Fl. Mal. 2 (1973) 371.
Sterculia alata Roxb., Hort. Beng. (1814)50; Corner, Ways. Trees 1 (1952) 619.

Sterculia angustifolia Roxb., Hort. Beng. (1814) 50; Ridl., Fl. 1 (1922) 274; Henders., J. Mal. Br. R As. Soc. 17 (1939) 37; Kochumm., Tree Fl. Mal. 2 (1973) 378.

Tree 10-13 m. Twigs, lower surface of leaves, and inflorescence rusty tomentose. Leaves membranous, oblong to obovate-lanceolate, base rounded, apex acute or acuminate, 10-17 by 3-6 cm. Panicles terminal and subterminal, lax, 5-15 cm long. Fruit ovate-oblong, about 7 by 3 cm, beak short.

Distributed in Burma, very rare in Malaya, known from a single collection from Gunong Pondok, Perak.

Sterculia lancaviensis Ridl., J. R. As. Soc. Str. Br. 54 (1911) 29, Fl. 1 (1922) 270; Henders., J. Mal. Br. R. As Soc. 17 (1939) 37.

Small deciduous tree. Leaves obovate, glabrous, about 9 by 4 cm; petioles 0.6-1.2 cm long. Panicles lax, much branched, 2-4 cm long, produced after fall of leaves. Flowers with campanulate perianth, male with 6 stamens. Fruits red with elliptic black seeds.

Distributed in southern Thailand and also from North Malaya. A species little known, probably restricted to limestone.

Sterculia rubiginosa Vent., Jard. Malm. 2 (1805) t. 91; Ridl., Fl. 1 (1922) 271; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 37.

(N.B. For note on Theaceae see p. 173)

THYMELAEACEAE

1. Leaves ovate or elliptic, apex acute to acuminate 2
   Leaves obovate, oblanceolate or elliptic-oblong, seldom elliptic, apex rounded or obtuse, rarely acute ..... *Wikstroemia indica*

2. Inflorescence racemose; rachis usually elongating, 0.5-4 cm long. Rare *Wikstroemia polyantha*
   Inflorescence umbelliform; rachis not elongating, very short, always less than 0.5 cm long. Not uncommon on craggy summits ..... *Wikstroemia androsaemifolia*

Wikstroemia androsaemifolia Decne, Ann. Sc. Nat. Bot. II, 20 (1843) 50; Hou, Fl. Mal. I, 6 (1960) 33; Back. & Bakh. f. Fl. Java 1 (1963) 269; Whitmore, Tree Fl. Mal. 2 (1973) 384.

Shrub 1-3.5 m. Young parts of twigs, buds and petioles finely pubescent. Leaves glabrous, rarely glabrescent, 2.5 by 1-2(-3) cm, base and apex acute; thin to subcoriaceous. Veins distinct below, obscured above. Inflorescence terminal or subterminal, umbelliform, 3-6(-10) flowered. Ovary ellipsoid or slightly obovoid, glabrescent or pubescent at the top. Fruits obovoid or oblong, 0.4-0.6 cm across, ripen red.

Distributed in Java, Borneo, Celebes and Western New Guinea; only recently recorded for Malaya (Whitmore l.c.). This is a forest plant, extending from coastal areas to over 2000 m. In Malaya it has been found to be restricted to limestone in Selangor, Kelantan and Pahang. Not rare and always on dry craggy summits. It is common on Bukit Takun, Selangor.

Wikstroemia indica (L.) C.A. Mey., Bull. Ac. Sc. St. Petersb. 1 (1843) 357; Hou, Fl. Mal. I, 6 (1960) 34; Back. & Bakh. f. Fl. Java 1 (1963) 296.
W. viridiflora Meisn., in Ridl., Fl. 3 (1924) 145; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 68.

Shrub 1-3 m tall. Leaves chartaceous to subcoriaceous, obovate, oblanceolate or sometimes elliptic, 1.5-4(-6) by 0.5-2 (-3) cm, base cuneate, apex rounded or obtuse, rarely acute. Flowers 0.8-1.2 cm long, greenish-yellow. Fruits broadly ellipsoid about 0.6 by 0.4 cm, ripening red.

Distributed in India, SE. Asia, Malesia and to Australia and Melanesia. In Malaya, frequently on limestone though not exclusive so, from the lowlands to the hills, up to 900 m. Common on limestone in the North.

Wikstroemia polyantha Merr., Philip. J. Sc. 10 (1915) Bot. 332; Ridl., Fl. 3 (1924) 145; Hou, Fl. Mal. I, 6 (1960) 32; Back. & Bakh. f., Fl. Java 1 (1963) 269.

Usually collected from the hills and mountains from 600 to 2050 m. Only once recorded from limestone at the low elevation of about 180 m. Gua Serai, Kelantan *(UNESCO 338)*.

TILIACEAE

1. Climbing or scrambling shrub ..... *Grewia acuminata*
   Shrubs or trees 2

2. Leaves oblong, lanceolate or ovate; lower surface densely or sparsely pubescent; base cuneate, obtuse or rounded, rarely cordate; petiole to 1.5 cm long 3
   Leaves ovate, broadly ovate to suborbicular; lower surface glabrous; base cordate; petiole 1.5-7 cm ..... *Berrya cordifolia*

3. Petioles kneed; fruit a winged capsule 4
   Petioles not kneed; fruit not winged, a drupe or berry 5

4. Leaf-bases almost symmetrical; rounded or cuneate ..... *Colona merguensis*
   Leaf-bases very asymmetrical; cordate ..... *Colona javanica*

5. Leaves glabrous on the upper surface; fruit drupaceous, with a stone 6
   Leaves sticky hairy all cover; fruit a fleshy berry, with numerous tiny seeds *Muntingia calabura*

6. Leaves abruptly acute; elliptic-oblong, oblong to oblong-obovate ..... *Grewia tomentosa*
   Leaves long acuminate; lanceolate to elliptic-lanceolate ..... *Grewia viminea*

Berrya cordifolia (Willd.) Burret, Notizbl. Berl.-Dahlem 9 (1926) 606; Kochumm., Tree Fl. Mal. 2 (1973) 393.
B. ammonilla Roxb., in Ridl., Fl. 1 (1922) 299; Henders., J. Mal. Br. As. Soc. 17 (1939) 38.

Tree to 10 m. Leaves alternate, ovate, broadly ovate to suborbicular; apex long and acuminate, base cordate; 5-7 nerved, glabrous, 6-17 by 3-15 cm. Inflorescence

a panicle, axillary and terminal, about 20 cm long. Calyx 3-5 lobed, petals 5, stamens many. Capsule winged.

Distributed in India, Ceylon, Andamans, Nicobars and W. Malaysia. Rare in Malaya, known only from Langkawi, Kedah; not known whether only on limestone.

Colona javanica (Bl.) Burret, Notizbl. Berl.-Dahlem 9 (1926) 733; B10. Back. & Bakh. f., Fl. Java 1 (1963) 394; Kochumm., Tree Fl. Mal. 2 (1973) 395.
Columbia integrifolia Ridl., Fl. 1 (1922) 306; Henders., J. Mal. Br. As. Soc. 17 (1939) 38.

Tree to 10 m. Leaves oblong or obovate-oblong. Shortly acuminate, very unequal-sided, cordate; lower surface pubescent, 4-30 by 1.5-8.5 cm. Inforescence terminal and axillary, to 17 cm long. Flowers with sepals 5 petals, stamens numerous. Fruits with 3 wings about 3 cm across the wings.

Distributed in Sumatra and Java. Very rare in Malaya, known only from a single collection, (Lenggong, Perak, *Ridley 14702)* on limestone.

Colona merquensis (Planch. ex Mast.) Burret, Notizbl. Berl.-Dahlem 9 (1926) 807; Kochumm., Tree Fl. Mal. 2 (1973) 395.
Columbia curtisii Ridl., Fl. 1 (1922) 307; Henders., J. Mal. Br. R. As. Soc. 1939.
C. diptera Ridl., Fl. l.c. 307.

Tree to 12 m. Leaves lanceolate, ovate-lanceolate to ovate, base rounded to broad-cuneate, 3-nerved, apex long pointed; lower surface sparsely tomentose, 6-18 by 2.5-5 cm. Inflorescence a lax terminal panicle, sparingly branched, to 15 cm. Flowers bracteate, sepals 5, petals 5, stamens numerous. Fruit 3- winged, including the wings about 3 cm across.

Distributed in lower Burma and Thailand. Restricted to Perlis and Langkawi, and nearly always confined to limestone; not uncommon.

Grewia acuminata Juss., Ann. Mus. Par. 4 (1804) 91; Back. & Bakh. f., Fl. Java 1 (1963) 393; Kochumm., Tree Fl. Mal. 2 (1973) 397.
G. umbellata Roxb., Fl. 1 (1922) 300.

Grewia paniculata Roxb. ex DC., Hort. Beng. (.1814) 93; Ridl., Fl. 1 (1922) 300; Kochumm., Tree Fl. Mal. 2 (1973) 397.
G. tomentosa Juss., in Corner, Ways. Trees 1 (1952) 643.

Grewia viminea Wall. ex Burret, Notizbl. Berl.-Dahlem 9 (1926) 713; Kochumm., Tree Fl. Mal. 2 (1973) 397.
G. polygama Roxb. var. *curtisii* Ridl., Fl. 5 (1925) 294; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 38.

Shrub. Leaves lanceolate-acuminate, base 3-nerved, lower surface pubescent, margin serrate, 7-10 by 1.8-2.5 cm. Inflorescence axillary, to 5 cm long. Fruit drupaceous, about 1.2 cm across.

Distributed in Burma and Thailand. In Malaya, only from Kedah and Perlis, restricted to limestone.

Muntingia calabura L., Sp. Pl. (1753) 509; Corner, Ways. Trees 1 (1952) 644; Stone, Fl. Guam (1970) 404.

Native of Tropical America, now over most of the Tropics. Common in Malaya, in cultivation or as escapes. Recorded from limestone of disturbed localities.

ULMACEAE

1. Leaves alternate, pubescent, scabrid on the upper surface; margin serrated. From secondary forest 2
   Leaves spiral, glabrous; margin entire. From primary forest ..... *Celtis philippensis*
2. Leaf-base symmetrical; lower surface of leaf with stellate and simple hairs ..... *Trema orientalis*
   Leaf-base mostly asymmetrical; lower surface of leaf with only simple hairs .... *Trema tomentosa*

Celtis philippensis Blanco, Fl. Filip (1837) 197; Soepadmo, Tree Fl. Mal. 2 (1973) 415; Fl. Mal. I, 8 (1977) 62.
C. collinsae Craib, in Ridl., Fl. 3 (1924) 322; Henders., J. Mal. R. As. Soc. 17 (1939) 72.
C. wightii Planch., Ann. Sc. Nat. 10 (1848) 307.

Shrub or small tree, 2-6(-10) m tall. Leaves elliptic, elliptic-oblong, oblong-lanceolate to ovate-lanceolate, glabrous, coriaceous; base distinctly 3-nerved; main nerves raised on the lower surface; petiole 0.5-1.2 cm; blade (3.5-)5-9(-12) by (1.3-)2-4(-6) cm. Inflorescence racemose, 0.5-1 cm long, with male flowers on the lower and hermaphrodite flowers on the upper parts. Fruits ovoid-globose, one seeded, about 1.2 cm long.

Distributed from tropical Africa across to Indochina and Hainan; throughout Malesia and to Australia and Solomon Islands. In Malaya, recorded from Perlis, Kedah, SW. Kelantan and NW. Pahang; restricted to limestone. Soepadmo l.c., records flowering in November-December and fruiting in March-May. Fruits have also been collected in August and November. It is quite common on the Langkawi limestone.

Trema orientalis (L.) Bl., Mus. Bot. Lugd. Bat. 2 (1856) 62; Hk.f., F.B.I. 5 (1885) 484; Corner, Ways. Trees 1 (1952) 694; Soepadmo, Tree Fl. Mal. 2 (1973) 421; Fl. Mal. I, 8 (1977) 51.
Celtis orientalis L., Sp. Pl. (1753) 1044.

Trema tomentosa (Roxb.) Hara, Bull. Univ. Mus. Univ. Tokyo 2 (1971) 19; Soepadmo, Tree Fl. Mal. 2 (1973) 423; Fl. Mal. I, 8 (1977) 53.
T. amboinensis Bl., in Ridl., Fl. 3 (1924) 319.

A common species throughout Malaya, which like *T. orientalis* has been recorded on disturbed areas on limestone as a component of secondary vegetation. This species is distinguished from *T. orientalis* by its leaf bases being mostly asymmetrical-cordate, by the hairs which are always simple, and by the more slender inflorescence.

URTICACEAE

1. Herbs, to 2m tall 2
   Shrubs or trees, much taller 7

2. Leaves very small, 0.2-0.6 cm long ..... *Pilea microphylla*
   Leaves much larger 3

3. Basal pair of nerves elongate, to ½ or more of the lamina 4
   Basal pair of nerves not elongate. A succulent herb ..... *Procris pedunculata*

4. Leaves inequilateral at the base; low herbs to 30 cm tall 5
   Leaves equilateral at the base; herbs (15-)30-100(-200) cm tall 6

5. Male cymes peduncled, branched ..... *Elatostema latifolium*
   Male cymes sessile, capitulate ..... *Elatostema curtisii*

6. Leaves small, 2-8 cm long, usually broadest near the middle, 3-nerved ..... *Pilea fruticosa*
   Leaves larger, 7-15 cm long, broadest near the base, 3-nerved at the base but with 2-5 other pairs ..... *Laportea interrupta*

7. Basal pair of nerves to at least ½ the blade 8
   Basal pair of nerves not elongate 9

8. Twigs with soft prickles ..... *Debregeasia squamata*
   Twigs without prickles ..... *Boehmeria nivea*

9. Leaves, lower surface glabrous; sometimes slightly mealy on the veins below, scrambling shrub ..... *Poikilospermum suaveolens*
   Leaves, lower surface, pubescent; especially on the veins, erect trees 10

10. Inflorescence 5-50 cm long; plant with stinging hairs 11
    Inflorescence 1-2 cm long; plant without stinging hairs ..... *Villebrunea sylvatica*

11. Flowers sessile ..... *Dendrocnide stimulans*
    Flowers pedicellate ..... *Dendrocnide sinuata*

Boehmeria nivea Hk. & Arn., Bot. Beech. Vey. 5 (1837) 214; Hk. f., F.B.I. 5 (1888) 576; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 72; Back. & Bakh. f., Fl. Java 2 (1965) 45.

Distributed in India, China, Japan and SE. Asia, widely cultivated. Recorded from limestone on Gunong Keriang, Kedah, perhaps as an escape from cultivation.

Debregeasia squamata King ex Hk.f., F.B.I. 5 (1888) 591; Ridl. Fl. 3 (1924) 368; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 73.

Shrub about 5 m tall, branches rough, tomentose and covered with soft prickles. Leaves ovate or orbicular, cuspidate, margin toothed, pubescent on both sides, 3-nerved from the base, 10-15 by 7-10 cm. Flower-heads in short-branched cymes about 1.2 cm long. Flowers orange, fruit red.

Endemic to Malaya, not common, usually on limestone.

Dendrocnide sinuata (Bl.) Chew, Gard. Bull. S. 21 (1965) 206; ibid. 25 (1969) 36. *Laportea pustulosa* Ridl., J. Str. Br. R. As. Soc. 82 (1920) 194, Fl. 3 (1924) 360; Molesworth-Allen, Gard. Bull. S. 20 (1964) 361.

Small tree, 3-11 m tall, with stinging hairs. Dioecious. Leaves elliptic, oblong or rhombic, rarely ovate or obovate, upper surface glabrescent 18-40(60) by 7-20(-35)

cm; petioles 6-20 cm long. Inflorescence unisexual: male 5-15 cm long; female 10-30 cm long; perianth 4-lobed. Achenes 0.3-0.5 cm long, pyriform, pustular.

Distributed in India, Ceylon, China, Burma, Vietnam, Thailand, Sumatra and Java. Known only from Perak in Malaya; until recent collections (all from limestone) by Molesworth-Allen, known only from Scortechinii's collection from upper Perak (not recorded whether from limestone).

Dendrocnide stimulans (L.f.) Chew, Gard. Bull. S. 21 (1965) 206, ibid, 25 (1969) 11.
Laportea stimulans (L.f.) Miq., Zoll. Syst. Verz. (1854) 103; Ridl., Fl. 3 (1924) 360; Molesworth-Allen, Gard. Bull. S. 20 (1964) 361.

Elatostema curtisii (Ridl.) Schrot., Rep. Beih. 83 (1935) 18; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 73.
Pellionia curtisii Ridl., J. Str. Br. R. As. Soc. 82 (1920) 196; Fl. 3 (1924) 362.

Endemic and rare. Recorded once from limestone. (from Rotan Segar, Tambun, Perak, *Molesworth-Allen 4652).*

Elatostema latifolium (Bl.) H. Schrot., Rep. Beih. 83 (1935) 17; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 73; Back. & Bakh. f., Fl. Java 2 (1965) 42.
Pellionia javanica (Wedd.) Wedd., in Ridl., Fl. 2 (1924) 362.

Laportea interrupta (L.) Chew, Gard. Bull. S. 21 (1965) 200, ibid. 25 (1969) 145.
Fleurya interrupta Gaud., in Ridl., Fl. 3 (1924) 359; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 74.

Pilea fruticosa Hk.f., F.B.I. 5 (1888) 558; Ridl., Fl. 3 (1924) 360; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 74.
P. calcarea Ridl., J. Str. Br. R. As. Soc. 82 (1920) 196, Fl. 3 (1924) 361; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 74.

Herb, 15-100 cm tall. Leaves elliptic, elliptic-ovate or elliptic-lanceolate, margin serrate or crenate, sometimes osbcurely so, base 3-nerved, glabrous, 2-8 (-10) by 1.2-4(-5) cm. Inflorescence axillary, 0.5-5 cm long, peduncle short or to 5 cm long. Flowers in small clusters; males: petals 2-4, stamens 2-4; females: petals 3, rarely 4. Achenes ovoid, about 0.1 cm long.

Endemic to limestone in Malaya, common except in the extreme Northwest. A herb of shady rocky places.

Pilea microphylla (L.) Lieb., Vidensk. Selsk. Skr. 5 (1951) 302; Henders., Mal. Wild Fls. Dicot. (1959) 466; Stone, Micronesica 6 (1970) 257.
Pilea muscosa Lindl., in Ridl., Fl. 3 (1924) 361.

Poikilospermum suaveolens (Bl.) Merr. Centr. Arn. Arb. 8 (1934) 47; Chew, Gard. Bull. S. (1963) 88.
Conocephalus amoenus King apud Hk.f., F.B.I. 5 (1888) 545; Ridl., Fl. 3 (1924) 357.
C. suaveolens Bl., in Ridl., l.c. 357.

Procris pedunculata (J.R. & G. Forst.) Wedd., in DC. Prod. 16 (1869) 191; Back. & Bakh. f., Fl. Java. 2 (1965) 44; Stone, Micronesica 6 (1970) 258.

Succulent herb, erect or sprawling, 30-150 cm tall. Leaves glabrous, elliptic-oblong, oblong-obovate, or oblong-lanceolate, margin undulate-dentate, or entire, 7-20 by 2-7 cm long. Male flowers in branched cymes, 1-7 cm long. Female flowers in dense sessile heads 0.5-1.5 cm across.

Distributed from Malesia to the Pacific Islands. Apparently not common in Malaya except on Bukit Anak Tukun limestone where it is abundant in shady parts.

Villebrunea sylvatica (Miq.) Bl., Mus. Bot. Lugd. Bat. 2 (1856) 167; Ridl., Fl. 3 (1924) 367.
Oreocnide sylvatica Miq., in Henders., J. Mal. Br. R. As. Soc. 17 (1936) 74.

VERBENACEAE

1. Leaves simple, entire or sometimes lobed 2
   Leaves with 3 or 3-5 leaflets 13

2. Lower surface of leaves glabrous or more or less pubescent; tomentum not completely covering surface 3
   Lower surface of leaves densely tomentose; tomentum usually completely covering surface, a dirty white or tawny colour 7

3. Surface of leaves strigose; flowers in umbels; plant prickly, with pungent odour ..... *Lantana camara* var. *aculeata*
   Surface of leaves not strigose, flowers in elongate racemes or panicles 4

4. Lower surface of leaves densely glandular; leaves usually lobed 5
   Lower surface of leaves not glandular 6

5. Leaves large 10-25 cm long, 3-7 lobed. Inflorescence a large terminal panicle ..... *Clerodendron paniculatum*
   Leaves smaller 3-6 cm long, lobed or not. Inflorescence a terminal raceme 2-5 cm long ..... *Gmelina asiatica*

6. Base of leaves gradually narrowed; leaves usually obovate-lanceolate; margin somewhat serrate ..... *Clerodendron serratum*
   Base of leaves not so. Leaves elliptic, elliptic-ovate or elliptic-oblong; margin entire ..... *Clerodendron pendulifolium*

7. Tomentum stellate (lens!) 8
   Tomentum not stellate 10

8. Inflorescence axillary, small or 7-10 cm long with peduncle 9
   Inflorescence terminal, about 30 cm long ..... *Premna pyramidata*

9. Leaves narrow: less than 3 cm wide. Inflorescence 8-16 flowered. Common on limestone, often on craggy summits. Sub-shrub or shrub ..... *Callicarpa angustifolia*
   Leaves broad: 5-13 cm wide. Inflorescence with numerous flowers. Rare on limestone. Tree ..... *Callicarpa arborea*

10. Bracts 3-4, leafy and showy, subtending the capitate cyme ..... *Congea vestita*
    Bracts if present, different 11

11. Petioles 1-5 cm long 12
    Petioles 0.2-0.3 cm long ..... *Glossocarya mollis*

12. Corolla large, 3-4 cm long, upper half dilated, campanulate ..... *Gmelina villosa*
    Corolla much smaller ..... *Gmelina rubens*

13. Very rare on limestone, never on dry craggy summits ..... *Vitex pubescens*
    Common and restricted to limestone, usually on dry craggy summits ..... *Vitex siamica*

Callicarpa angustifolia K. & G., Kew Bull (1908) 106; Ridl., Fl. 2 (1923) 616; Henders., J. Mal. Br. As. Soc. 17 (1939) 64.

Subshrub or shrub, 1-2-3 m tall, slender and tawny tomentose. Leaves opposite, subcoriaceous, 8-15 by 1.8-3 cm, elliptic-lanceolate; upper surface becoming glabrous with age, lower surface with a dense mat of fine stellate scales. Cymes axillary, 2 times dichotomously branched, about 1 cm long, 8-16 flowered. Drupe globose, ripens black.

Endemic to Malayan limestone; usually on dry craggy summits, preferring exposed situations but tolerating part shade. Widely distributed.

Callicarpa lanata L., Mant. 2 (1767) 331; Hk.f., F.B.I. 4 (1885) 567; Lam, Verb. Mal. Arch., Thesis, Utrecht (1919) 79.
C. arborea Roxb., in Ridl., Fl. 2 (1923) 614; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 65.

Clerodendron paniculatum L., Mant. 1 (1767) 90; Lam, Verb. Mal. Arch., Thesis, Utrecht (1919) 295; Ridl., Fl. 2 (1923) 628; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 65.

Frequently cultivated. Not uncommon in waste ground and forest fringes; recorded from limestone on the summit of Gunong Baling; not known whether wild or an escape from cultivation.

Clerodendron penduliflorum Wall., Cat. (1828) 1795; Hk.f., F.B.I. 4 (1885) 591; Lam. Verb. Mal. Arch., Thesis, Utrecht (1919) 265; Ridl., Fl. 2 (1923) 626; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 65.

Clerodendron serratum Spr., Syst. 2 (1825) 578; Hk.f., F.B.I. 4 (1885) 592; Lam. Verb. Mal. Arch., Thesis, Utrecht (1919) 267; Ridl., Fl. 2 (1923) 626; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 65.

Congea vestita Griff., Notul. Pl. As. 4 (1854) 174; Lam, Verb. Mal. Arch., Thesis, Utrecht (1919) 338; Ridl., Fl. 2 (1923) 640; Munir, Gard. Bull. S. 21 (1966) 302.
C. tomentosa Roxb., in Hk.f., F.B.I. 4 (1885) 603.

Glossocarya mollis Wall., Cat. (1829) 1741; Hk.f., F.B.I. 4 (1885) 598; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 65.

Scandent shrub. Twigs, lower surface of leaves and inflorescence grey-villose. Leaves opposite, ovate, ±8 by 4 cm; petioles very short. Corymbs ±7 cm across. Corolla white, 0.8 cm long, filaments exserted.

Distributed in peninsular Thailand. Recorded on limestone by Henderson from Pulau Rabana off Kuala Perlis, otherwise unknown in Malaya.

Gmelina asiatica L., Sp. Pl. (1753) 873; Lam, Verb. Mal. Arch., Thesis, Utrecht (1919) 221; Ridl., Fl. 2 (1923) 662.

Gmelina villosa Roxb., Fl. Ind. 3 (1832) 86; Lam, Verb. Mal. Arch. Thesis. Utrecht (1919) 217; Ridl., Fl. 2 (1923) 623.

Not uncommon, coastal and in secondary vegetation inland. Recorded from limestone at the base of hills on disturbed ground.

Lantana camara L., Sp. Pl. (1753) 627.

var. *aculeata* (L.) Moldenke, Torreya 34 (1934) 9; Stone, Micronesica 6 (1970) 506.
L. aculeata L., Sp, Pl. (1753) 627; Ridl., Fl. 2 (1923) 613.

Premna pyramidata Wall., Cat. (1927) 1779; Lam, Verb. Mal. Arch., Thesis, Utrecht (1919) 155; Ridl., Fl. 2 (1923) 622; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 65.

Premna rubens Ridl., Fl. 2 (1923) 618.
P. flavescens var. *rubens* Cl. in Hk.f., F.B.I. 4 (1885) 578.

This species is probably endemic to Malaya (doubtfully recorded from Java), it is rare and recorded once from limestone.

Vitex pubescens Vahl, Symb. Bot. 3 (1794) 85; Lam, Verb. Mal. Arch., Thesis, Utrecht (1919) 183; Ridl., Fl. 2 (1923) 632; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 65.

Vitex siamica Will., Bull. Herb. Boiss. Ser. 2, 5 (1905) 431; Lam, Verb. Mal. Arch., Thesis, Utrecht (1919) 197; Ridl., Fl. 2 (1923) 632; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 65.

Tree 5-10 m tall. Leaves 3-foliolate; leaflets subcoriaceous, glabrous, entire, ovate or ovate-lanceolate, lateral leaflets sometimes slightly asymmetric, slightly smaller than the terminal one; terminal leaflet 6-9(-12) by 1.8-4 cm. Panicles terminal 10-30 cm long; corolla light blue or white, tube about 0.25 cm long. Drupe globose 0.3-0.4 cm across.

In Malaya, this species is restricted to limestone where it is common except in Perak; also recorded from peninsular Thailand. This plant is usually found on the upper parts of hills and often on dry craggy summits, precariously rooted in cracks and crevices.

VIOLACEAE

1. Capsule pubescent with long soft spines. Leaves pubescent below ..... *Rinorea anguifera*
   Capsule glabrous, sometimes warty. Leaves glabrous or pubescent along veins only 2
2. Capsule ovoid-acute, apex pointed. Leaves usually with a long acuminate tip 2-4 cm long, pubescent on the nerves below ..... *Rinorea horneri*
   Capsule globose or ovoid, apex rounded. Leaves without a long drawnout tip, sometimes abruptly acuminate 3

3. Leaves hairy on the veins below. Very rare on limestone ..... *Rinorea macrophylla*
   Leaves glabrous. Found on most hills ..... *Rinorea bengalensis*

Rinorea anguifera (Lour.) O. Kuntze, Rev. Gen. Pl. 1 (1891) 42; Jacobs, Blumea 15 (1967) 127.
Alsodeia capillata King, in Ridl., Fl. 1 (1922) 133.
A. comosa King, in Ridl., l.c. 133.
A. echinocarpa Korth, in Ridl., l.c. 134.

Rinorea bengalensis (Wall.) O. Kuntze, Rev. Gen. Pl. 1 (1891) 42; Jacobs, Blumea 15 (1967) 120.
R. wallichiana O. Kuntze, Henders., J. Mal. Br. R. As. Soc. 17 (1939) 35.
Alsodeia langkawiensis Ridl., Fl. 1 (1922) 129.
A. wallichiana Hk.f., in Ridl., l.c. 128.

Shrub or small tree, 2-6 m tall. Leaves variable, (4-)8-15(-20) by (1.5-)3-6(-8) cm; chartaceous to coriaceous, glabrous. Fruit, globose to ovoid, bluntly 3-angled, surface finely warty to almost smooth, about 1 cm long.

Widely distributed from India, Ceylon, Burma, through Malesia and to northern Australia. Common and found on a large number of limestone hills in Malaya; also in lowland forest.

Rinorea horneri (Korth.) O. Kuntze, Rev. Gen. Pl. 1 (1891) 42; Jacobs, Blumea 15 (1967) 130.
R. kunstleriana Taub., in Henders. J. Mal. Br. R. As. Soc. 17 (1939) 35.
Alsodeia hirtella Ridl., Fl. 1 (1922) 128.
A. kunstleriana King, in Ridl., l.c. 128.

Widely distributed and fairly common on limestone except in the North. Usually in partly shaded localities with some accumulation of soil.

Rinorea macrophylla (Decne.) O. Kuntze, Rev. Gen. Pl. 1 (1891) 42; Jacobs, Blumea 5 (1967) 135.
R. dasycaula Craib, in Henders., J. Mal. Br. R. As. Soc. 17 (1939) 35.
Alsodeia dasycaula Miq., in Ridl., Fl. 1 (1922) 129.

VITACEAE

1. Climbers, usually with tendrils 2
   Not climbers 17

2. Flowers on a flattened, undulating rachis ..... *Pterisanthes coriacea*
   Flowers in a spicate or cymose inflorescence, rachis terete or subterete 3

3. Leaves simple, lobed or not 4
   Leaves 3-5 or more foliolate 11

4. Back of leaves pubescent or densely tomentose 5
   Back of leaves usually glabrous, rarely minutely pubescent 7

5. Leaves trilobed, cordate ..... *Vitis martinelli*
   Leaves not lobed, ovate-cordate or oblong-ovate 6

6. Leaves cordate, back densely tomentose, pale brownish or rusty red colour ..... *Cissus pyrrhodasys*
Leaves hardly cordate, back pubescent or tomentose, but of a different colour ..... *Tetrastigma scortechinii*

7. Leaves varigated with red and white ..... *Cissus discolor*
Leaves not so 8

8. Stem winged, 4-angled, glaucous ..... *Cissus hastata*
Stem not winged, at most angular 9

9. Leaves distinctly cordate, petioles 4-5 cm long ..... *Cissus repens*
Leaves with broad bases, shortly cuneate or only slightly cordate; petioles 1-3 cm long 10

10. Leaves ovate-acuminate to lanceolate, somewhat coriaceous. Ripe fruits, black *Cissus rostrata*
Leaves elliptic-cuspidate, herbaceous. Ripe fruits, red ..... *Cissus glaberrima*

11. Petals free, disc not lobed, stigma dilated and 4-lobed 12
Petals connate, falling in a cap, disc 4-lobed, stigma much reduced 15

12. Leaves digitately 3-foliolate 13
Leaves 3-5 foliolate; if 3-foliolate, then ripe fruits white 14

13. Leaves coriaceous, glaucous on the lower surface with prominent reticulations. Corymbs, on wood ..... *Tetrastigma peduncularis*
Leaves not so. Corymbs, not on old wood ..... *Tetrastigma wrayi*

14. Fruit pulpy ..... *Tetrastigma lanceolarium*
Fruit dry ..... *Tetrastigma kunstleri*

15. Leaves 7-9 foliolate ..... *Cissus novemfolia*
Leaves 3 or 3-5 foliolate 16

16. Stem with long hairs, leaves 3 foliolate, hairy ..... *Cayratia mollissima*
Stem glabrous or finely pubescent, leaves 3-5 foliolate, softly pubescent or glabrous on the undersurface ..... *Cayratia japonica*

17. Plant with very short erect stem ..... *Leea saxatilis*
Plant with stem 1-5 m tall 18

18. Branches of inflorescences and the outside of petals red, leaves large, imperfectly 3-pinnate ..... *Leea rubra*
Branches of inflorescences and the outside of petals green, leaves usually imperfectly 2-pinnate 19

19. Lower surface of adult leaves densely covered by scales. Corymbs 5-10 cm wide ... *Leea aequata*
Lower surface of adult leaves not with scales, hairy or not. Corymbs 5-35 cm wide ..... *Leea sambucina*

Cayratia mollissima (Wall.) Gagn., Notul. Syst. 1 (1911) 345.
Vitis mollissima Wall., in Roxb., Fl. Ind. 2 (1832) 482; King, Mats. 8 (1896) 402; Ridl., Fl. 1 (1922) 478; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 42.

Common on the edges of forest. Recorded from limestone in Perlis, Perak and Kelantan, rare.

Cissus discolor Bl., Bijdr. (1825) 181; Back. & Bakh. f. Fl. Java 2 (1965) 91.
Vitis discolor (Bl.) Dalz., in Kew J. 2 (1850) 39; King, Mats. 8 (1896) 399; Ridl., Fl. 1 (1922) 477.

Slender climber, stems red. Leaves simple, ovate-oblong-lanceolate, base cordate or truncate, dark green, variegated with red and white; pink below, 5-10 by 2-5 cm. Fruit pyriform or globose.

Widely distributed from India to Thailand and southwards to Sumatra. In Malaya, chiefly in the North and usually on limestone.

Cissus glaberrima (Wall.) Steud., Nom. Bot. ed. 2. 1 (1840) 372.
Vitis glaberrima Wall., in Roxb., Fl. Ind. 2 (1832) 476; King, Mats. 8 (1896) 401; Ridl., Fl. 1 (1922) 477; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 41.

Cissus hastata Miq., Fl. Ind. Bot. Suppl. 1 (1861) 517; Back. & Bakh. f., Fl. Java 2 (1965) 92.
Vitis hastata (Miq.) Miq., Ann. Mus. Bot. Lugd. Bat. 1 (1863) 85; Ridl., Fl. 1 (1922) 478; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 41.

Cissus novemfolia (Wall.) Planch., in DC., Monog. Phan. 5 (1887) 559.
Vitis novemfolia Wall., Cat. (1832) 6030; Law., in Hk.f., F.B.I. 1 (1875) 662; King, Mats. 8 (1896) 403; Ridl., Fl. 1 (1922) 479; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 42.

Cissus pyrrhodasys Miq., Fl. Ind. Bot. Suppl. 1 (1861) 517.
Vitis pyrrhodasys (Miq.) Ridl., Fl. 1 (1922) 476; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 42.

Cissus repens Lamk., Encycl. 1 (1783) 31; Gagn., Fl. Gen. Indo-China 1 (1912) 970.
Vitis repens (Lamk.) Wight et Arn., Prod. Fl. Ind. Pens. (1834) 125; Ridl., Fl. 1 (1922) 477; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 42.

Cissus rostrata (Miq.) Planch., in DC., Monog. Phan. 5 (1887) 500; Back. & Bakh. f., Fl. Java 2 (1965) 90.
Vitis furcata Laws., in Hk.f., F.B.I. 1 (1875) 646; Ridl., Fl. 1 (1922) 476.

Leea aequata Mant. (1767) 124; King, Mats. 8 (1896) 418; Ridl., Fl. 1 (1922) 486; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 41; Back. & Bakh. f., Fl. Java 2 (1965) 94.

Leea rubra Bl., Bijdr. (1825) 197. King, Mats. 8 (1896) 416; Ridl., Fl. 1 (1922) 485; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 41; Back. & Bakh. f., Fl. Java 2 (1965) 94.

Leea sambucina Willd., Sp. Pl. 1 (1798) 1177; King, Mats. 8 (1896) 414; Ridl., Fl. 1 (1922) 484; Back. Bakh. f., Fl. Java 2 (1965) 94.

Leea saxatilis Ridl., J. Str. Br. R. As. Soc. 75 (1917) 26, Fl. 1 (1922) 486.

Plant with a very short erect stem. Leaves pinnate, petioles to 45 cm long, leaflets usually 10-17 by 5 cm, glabrous, when adult, corymb about 2 cm across. Drupe to 0.8 cm across, red when ripe.

Endemic, uncommon and often on limestone.

Pterisanthes coriacea Korth. ex Miq., Ann. Mus. Bot. Lugd. Bat. 1 (1863) 95; King, Mats. 8 (1896) 407; Ridl., Fl. 1 (1922) 480.

Tetrastigma kunstleri (King) Craib, Fl. Siam Enum. 1 (1926) 313.
Vitis kunstleri King, Mats. 8 (1896)) 396; Ridl., Fl. 1 (1922) 475.

Endemic to Malaya, found in forests and often on limestone.

Tetrastigma lanceolarium (Roxb.) Planch., in DC., Monog. Phan. 5 (1887) 433; Back. & Bakh. f., Fl. Java 2 (1965) 89.
Vitis lanceolaria (Roxb.) Wall., Cat. (1832) 6013; King, Mats. 8 (1896) 395; Ridl., Fl. 1 (1922) 475; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 41.

Tetrastigma peduncularis (Wall.) Planch., in DC., Monog. Phan. 5 (1887) 438.
Vitis peduncularis Wall., Cat. (1832) 6024; Law., in Hk.f., F.B.I. 1 (1875) 655; King, Mats. 8 (1896) 393; Ridl., Fl. 1 (1922) 474.

Tetrastigma scortechini (King) Gagn., in Lec., Notul. Syst. 1 (1911) 376.
Vitis scortechinii King, Mats. 8 (1896) 392; Ridl., Fl. 1 (1922) 474; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 42.

Glabrous climber. Leaves simple, oblong-ovate, subcoriaceous, 12-18 by 6-9 cm. Cymes compact, ±2.5 cm across. Fruits small: ±0.6 cm across, waxy white when ripe.

Endemic and as far as the records go, restricted to limestone. Recorded only from Gunong Pondok, Perak and according to Ridley, from Gua Batu, Selangor as well.

Tetrastigma wrayi (King) Craib, Fl. Siam. Enum. 1 (1926) 314.
Vitis wrayi King, Mats. 8 (1896) 394; Ridl., Fl. 1 (1922) 475.
Endemic and found in forests, not uncommon. Recorded on limestone only from Kedah and Selangor.

Vitis martinelli Kew ex Planch, in DC., Monog. Phan. 5 (1887) 375; Ridl., Fl. 1 (1922) 471.

Dubious record

Cayratia japonica (Thunb.) Gagn., Notul. Syst. 1 (1911) 349; Back. Bakh. f., Fl. Java 2 (1965) 93.
Vitis japonica Thunb., Fl. Jap. (1784) 104; King, Mats. 8 (1896) 403; Ridl., 1 (1922) 478; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 41.

NOTE

THEACEAE (TERNSTROEMIACEAE)

Henderson in J. Mal. Br. R. As. Soc. 17 (1939) 37 records *Saurauia cauliflora* Bal. var. *calycina* King and *Schima noronhae* Reinw. as dubious records from limestone. I have, however, not come across any specimens from limestone and, therefore, am omitting this family. (*Saurauia* is now generally treated as belonging to the family Saurauiaceae).

Angiosperms — Monocotyledons

AGAVACEAE

The following key to *Draceaena,* based on what few specimens I have seen and the scanty literature available, should be regarded as provisional. This genus needs a through revision.

1. Twigs stout, 2-3 cm across ..... *Dracaena yuccaefolia*
   Twigs slender, usually less than 1 cm across 2
2. Leaves elliptic to elliptic-lanceolate, 5-8 cm wide ..... *Dracaena congesta*
   Leaves linear or lanceolate, 1-3.5 cm wide 3
3. Leaves 50-75 cm long ..... *Dracaena curtisii*
   Leaves 15-40 cm long 4
4. Leaves 1.5-3.5 cm wide ..... *Dracaena porteri*
   Leaves 0.8-1.3 cm wide 5
5. Flowers in clusters of 3-4 on the inflorescence axis ..... *Dracaena graminifolia*
   Flowers in pairs or single on the inflorescence axis 6
6. Flowers 1.5-2.5 cm long ..... *Dracaena angustifolia*
   Flowers 3-4 cm long ..... *Dracaena nutans*

Dracaena angustifolia Roxb., Hort. Beng. (1814) 24; Hk.f., F.B.I. 6 (1894) 327.
Pleomele angustifolia (Roxb.) N.E. Br., Kew Bull. 8 (1914) 277.

Dracaena congesta Ridl., Trans. Linn. Soc. 3 (1893) 388; Fl. 4 (1924) 334; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 81.
D. pachyphylla Kurz., Hk.f., F.B.I. 6 (1894) 329, *p.p.*

Plant short, stem to 15 cm tall. Leaves elliptic-lanceolate, 20-25 by 5-8 cm. Petioles broad, slightly sheathing at the base. Inflorescence short, many flowered.

Distributed in Borneo; in Malaya often though not always on limestone, in shady places.

Dracaena curtisii Ridl., Jour. R. As. Soc. S. Br. 59 (1911) 210; Fl. 4 (1924) 333; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 81.

Leaves linear-lanceolate, 50-75 by 2-3 cm. Inflorescence large: to 70 cm long; flowers 4-6 together.

Found in peninsular Thailand and Langkawi only. Perhaps restricted to limestone; the collectors' labels are very brief and incomplete.

Dracaena graminifolia Wall., Cat. (1831-32) 5149; Hk.f., F.B.I. 6 (1894) 327; Ridl., Fl., 4 (1977) 333.
D. finlaysonii Bak., J. Bot. (1873) 261.

Plant to 60 cm tall. Leaves linear acuminate, about 39 by 1 cm. Raceme usually simple, sometimes branched at the base. Flowers 3-4 together, white.

Endemic to Malaya; not common in forests. Recorded from limestone only from a single locality (Gunong Rapat, Ipoh).

Dracaena nutans Ridl., Trans. Linn. Soc. 3 (1893) 406; Fl., 4 (1924) 337.
Pleomele nutans N.E. Br., Kew Bull. 8 (1914) 278.

A rare endemic to Malaya; once recorded from limestone Batu Bayan, Kelantan *(UNESCO 178)*.

Dracaena porteri Bak., J. Bot. (1873) 262; Hk.f., F.B.I. 6 (1894) 328; Ridl., Fl. 4 (1924) 333.
Pleomele porteri N.E. Br., Kew Bull. 8 (1914) 279.

Endemic to Malaya, once recorded from limestone.

Dracaena yuccaefolia Ridl., J. Bot. (1896) 168, Fl. 4 (1924) 338; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 81.

Plant to 5 m tall. Leaves crowded at the end of stout twigs, stiff coriaceous, ensiform, to 40 by 2.5 cm wide, often broader. Panicle large and spreading.

Distributed in peninsular Thailand and on limestone in the extreme North of Malaya. Known only from these parts and probably restricted to limestone.

DUBIOUS RECORD

ALISMATACEAE

Echinodorus ridleyi Steen., Arch. Hydrobiol. Suppl. 11 (1932) 240; Den Hartog, Fl. Mal. I, 5 (1957) 325.
Ranalisma rostrata Stapf. in Hk. Ic. Pl. (1900) t. 2652; Ridl., Fl. 4 (1924) 362.

Distributed in Vietnam and in Malaya. Known only from 3 or 4 collections, very rare. In Malaya recorded only from Gua Batu woods, *Ridley 8464* and *Scortechini 126* (Den Hartog l.c., 326). Noted by Ridley on his label as from 'damp spot in wood': and in his Flora l.c. as 'in a patch of black mud in dense forest': this is a plant of wet places, and the aquatic more than the calcareous elements, apart from other factors unknown, probably restrict its distribution. Probably, both Ridley's and Scortechini's are not from the limestone at Gua Batu but from the surrounding forest.

AMARYLLIDACEAE

Leaves broadly ovate, petiolate ..... *Eurycles amboinensis*
Leaves strap-shaped, not petiolate ..... *Crinum defixum*

Crinum defixum Ker., Quart. J. Sci. & Art, 3 (1817) 105; Hk.f. F.B.I. 6 (1894) 281; Ridl., Fl. 5 (1925) 301; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 81.

Eurycles amboinensis (L.) Loud., Encycl. Pl. (1829) 242; Back. & Bakh. f., Fl. Java 3 (1968) 140.
Eurycles sylvestris Salisb., Trans. Hort. Soc. 1 (1812) 337; Ridl., Fl. 4 (1924) 303; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 81.

ARACEAE

1. Plants prickly 2
   Plants not prickly 3

2. Leaves sagittate, the 2 basal lobes triangular; spathe broad, slightly longer than spadix ..... *Cyrtosperma lasioides*
   Leaves deeply incised, with 4-8 pairs of lobes; spathe narrow, much longer than spadix ..... *Lasia aculeata*

3. Plants aquatic, often completely submerged; on sandy, gravelly or rocky stream beds 4
   Plants not aquatic, rarely on dripping boulders, but never completely submerged 6

4. Limb of spathe spirally twisted; leaves purple-reddish below; plants often forming dense mats on stream bed ..... *Cryptocoryne affinis*
   Limb of spathe not twisted 5

5. Limb of spathe 1.3-2.5 cm long; leaves to 7-8 by 4 cm ..... *Cryptocoryne purpurea*
   Limb of spathe ±0.6 cm long; leaves to 5 by 2 cm; a smaller plant ..... *Cryptocoryne minima*

6. Stem short or long, erect or subterranean, or sometimes prostrate, but not climbing, not rooting from the nodes or internodes 7
   Stem usually long, climbing, rooting from the nodes or from both nodes and internodes 29

7. Plant with 1-2 leaves 8
   Plant with more than 2 leaves 14

8. Leaf blade entire, ovate and cordate; margin undulate ..... *Hapaline brownei*
   Leaf blade lobed 9

9. Leaf trifoliate, leaflets simple and entire; a second leaf often present; spadix with filiform appendage 10
   Leaf usually more divided; always single; spadix without filiform appendage 11

10. Spadix much longer than spathe; with filiform appendage protruding ..... *Arisaema fimbriatum*
    Spadix not longer than spathe, appendage not protruding ..... *Arisaema roxburghii*

11. Appendage of spadix massive, conic 12
    Appendage of spadix long and cylindrical 13

12. Limb of spathe yellow; petiole to 200 cm long ..... *Amorphophallus prainii*
    Limb of spathe pinkish; petiole to 40 cm long ..... *Amorphophallus carnosus*

13. Peduncle to 30 cm long; leaf trifid with oblong-lanceolate leaflets ..... *Amorphophallus haematospadix*
    Peduncle 90-120 cm long; leaf trifid with pinnatisect lobes ..... *Amorphophallus variabilis*

14. Spadix with a conical or cylindrical appendage projecting above the male flowers 15
    Spadix not projecting above the male flowers 20

15. Plant small, petioles 1-12 cm long 16
    Plant usually much larger, petioles at least 20 cm long, often much more 17

16. Plant with small underground tuber; petioles 5-12 cm long ..... *Typhonium filiforme*
    Plant without tuber, stem supported by short stilt roots, petioles about 1 cm long ..... *Typhonium fultum*

17. Spathe slightly constricted below the middle, upper half narrow; peduncles less than 10 cm long ..... *Schismatoglottis mutata*
    Spathe prominently constricted, the upper half broad; peduncles usually more than 10 cm long 18

18. Fruit drupaceous; seeds 1-3; leaves often pointing upwards 19
    Fruit a berry; seeds numerous; leaves often pointing downwards. Large plant, leaves usually more than 100 cm long ..... *Colocasia gigantea*

19. Leaves dark green, veins and margin white; styles distinct ..... *Alocasia lowii*
    Leaves without prominent white veins and margin; stigma sessile ..... *Alocasia denudata*

20. Spathe boat-shaped, the whole dropping off as the fruit develops 21
Spathe either with a constriction in the middle or if boat-shaped, then persistent 22

21. Stem erect, 30-60 m tall; spadices several together; peduncles 10-12 cm long .....
..... *Aglaonema oblongifolium*
Stem (rhizome) short creeping; spadix solitary; peduncles about 7 cm long .....
..... *Aglaonema costatum*

22. Spathe with a constriction, the upper half soon falling off 23
Spathe with or without a constriction, the upper half persistent 24

23. Upper half of spadix club-shaped; leaves not peltate ..... *Schismatoglottis calyptrata*
Upper half of spadix not club-shaped; leaves peltate ..... *Colocasia esculenta*

24. Leaves ovate or lanceolate 25
Leaves cordate or sagittate 27

25. Spathe 2.5-3 cm long, green, peduncles about 4 cm long; stem of plant to 12 cm long .....
..... *Homalomena griffithii*
Spathe ±1.2 cm long; leaves silvery or velvety 26

26. Leaf base asymmetrical, petioles to 5 cm long; male part of spadix about 3 times as long as the female. Leaves silvery ..... *Homalomena argentea*
Leaf base symmetrical, petioles variable, to 16 cm long; male part of spadix about twice as long as the female. Leaves velvety ..... *Homalomena humilis* (sometimes)
Leaf base prominently cordate or sagittate 28

27. Leaf base slightly cordate; a small plant, stem ±2.5 cm long .....
..... *Homalomena humilis* (sometimes)
Leaf base prominently cordate or sagittate 28

28. Leaves, petioles and spathe tinged red or red; spathe ±7 cm long. Spadix not clubbed .....
..... *Homalomena rubra*
Leaves, petioles and spathe not so coloured; spathe ±2.5 cm long. Spadix clubbed .....
..... *Homalomena deltoidea*

29. Adult leaves deeply lobed and sometimes perforated 30
Adult leaves not lobed, very rarely perforated 32

30. Adult leaves lobed and perforations close to and on either side of the midrib; juvenile leaves not lobed, bases overlapping; spadix shorter than spathe ..... *Epipremnopsis media*
Adult leaves lobed but not perforated 31

31. Leaves lanceolate, with ±3 pairs of lobes or unlobed; spathe ±7 cm long *Raphidophara beccarii*
Leaves ovate-elliptic, with numerous lobes; spathe 12-22 cm long ..... *Raphidophora korthalsii*

32. Very large climber; leaves coriaceous, ±30-90 by 15-30 cm; spathe stiff ±23-35 cm long .....
..... *Epipremum giganteum*
Smaller climber; leaves & spathe less massive 33

33. Spadix with a stalk between the fertile part and the junction with the spathe 34
Spadix without stalk; fertile up to the junction with spathe 40

34. Leaves with 1-2 distinct veins close to and parallel with the margin; petioles often flat and broadly winged 35
Leaves not so; petioles never flat and winged, sometimes with sheaths 38

35. Petioles flat and winged; spadix globose 36
Petioles not flat or winged; spadix elongate 37

36. Peduncles up to ±2.5 cm; stalk of spadix ±0.5 cm; leaf blades elliptic ..... *Pothos scandens*
Peduncles ±5 cm long; stalk of spadix ±1 cm; leaf blades narrow. Inflorescence generally larger
..... *Pothos macrocephalus*

37. Leaf elliptic, petiole with a prominent 0.6-cm long knee; spadix 7-15 cm long .... *Pothos latifolius*
Leaf lanceolate, knee inconspicuous; spadix usually less than 7 cm long ..... *Pothos lorispatha*

38. Petioles broadly sheathing, nearly to the top ..... *Anadendrum marginatum*
Petioles not sheathing to near the top 39

39. Leaf base broad, sometimes slightly cordate; sheath to 7 cm of the petiole .....
..... *Anadendrum montanum*
Leaf base narrowed, sheath at the base of the petiole only ..... *Anadendrum latifolium*

40. Leaves as wide or almost as wide as long, broadly ovate-cordate; petiole 15-30 cm long, not sheathing. Spathe ±3 cm long, boat-shaped ..... *Amydrium humile*
Leaves longer than wide 41

41. Petioles prominently long sheathing, sheath persistent; peduncle enclosed by the sheaths. Fruit drupaceous, one-seeded 42
Petioles not prominently sheathing, often without sheaths; sheaths if present not persisting. Fruit a berry; seeds numerous 44

42. Spadix 10-15 cm long; stem very thick; petioles broadly winged, leaves ±25 by 6 cm .....
..... *Scindapsus perakensis*
Spadix less than 5 cm long; stem slender, ±1 cm in diameter 43

43. Leaves ovate acute, base broad; stem slender: less than 1 cm diameter; spathe 3-5 cm long, ovate
..... *Scindapsus scortechinii*
Leaves lanceolate with base acute; stem to 1 cm diameter; spathe 3-5 cm long, narrow .....
..... *Scindapsus hederaceus*

44. Spadix ±5-7 cm long; stem less than 1 cm diameter ..... *Raphidophora silvestris*
Spadix more than 10 cm long; stem usually more than 1 cm diameter 45

45. Petiole more than 25 cm long; spathe to 20 cm long; stem very stout ..... *Raphidophora kunstleri*
Petiole very short, inconspicuous; spathe to 12 cm long; stem 1-1.5 cm diameter .....
..... *Raphidophora maingayi*

Aglaonema costatum N.E. Br., Gard. Chron. 1 (1892) 426; Hk.f., F.B.I. 6 (1894) 531; Ridl., Fl. 5 (1925) 100; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 83.

Rhizome creeping. Leaves lanceolate to ovate-acute, base broad. Spathe ±2.5 cm long, spadix protruding.

Endemic, and apart from Hooker's reference to a collection by Curtis from Perak, known only from Langkawi; it is not certain whether this species is restricted to limestone.

Aglaonema oblongifolium Schott., Wien Zeitschr. 3 (1829) 892; Hk.f., F.B.I. 6 (1894) 528; Ridl., Fl. 5 (1925) 100.
A. nitidum Kunth., Enum. 3 (1841) 55.

Alocasia denudata Engl. in DC., Monog. Phan. 2 (1879) 507; Hk.f., F.B.I. 6 (1894) 525; Ridl., Fl. 5 (1925) 97.
A. longiloba Miq., in Hk.f., F.B.I. 6 (1894) 527; Henders., J. Mal. Br. R. As. Sco. 17 (1939) 83.

Alocasia lowii Hk.f., Bot. Mag. 3 (19) (1863) t.5376; Ridl., Fl. 5 (1925) 98; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 83.

Amorphophallus carnosus Ridl., J. Str. Br. R. As. Soc. 41 (1904) 47; Fl. 5 (1925) 94; Henders., J. Mal. Br. R. As. Sco. 17 (1939) 83.

Tuber small; petiole about 35 cm tall; spathe about 12 cm long.

Found only in northern Malaya and the southern part of peninsular Thailand, all records are from limestone.

Amorphophallus haematospadix Hk.f., F.B.I. 6 (1894) 517; Ridl., Fl. 5 (1925) 94; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 83.

Tubers to 6 cm diameter; petioles to 60 cm long, thick. Peduncle about 25 cm long; spathe to 13 cm long.

Distributed in northern Malaya and peninsular Thailand and probably restricted to limestone although the records are not clear. Hooker referred to a specimen collected by Curtis as doubtfully from Penang where there are no limestone outcrops.

Amorphophallus prainii Hk.f., F.B.I. 6 (1894) 516; Ridl., Fl. 5 (1925) 94; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 83.

The commonest forest species. Recorded from limestone in Pahang, Kelantan (fide Henderson) and doubtfully from Selangor.

Amorphophallus variabilis Bl., Rumphia, 1 (1837) 146; Ridl., Fl. 5 (1925) 95; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 83.
Amorphophallus elatus Hk.f., F.B.I. 6 (1894) 517.

Amydrium humile Schott, Ann. Mus. Bot. Lugd. Bat. 1 (1863) 127; Ridl., Fl. 5 (1925) 118; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 83.
Epipremum humile Hk.f., F.B.I. 6 (1894) 549.

Anadendrum latifolium Hk.f., F.B.I. 6 (1894) 540; Ridl., Fl. 5 (1925) 115.

Endemic to Malaya, not common in forest; with one record from limestone, climbing over rocks (Gua Panjang, Kelantan, *Henderson 19600*).

Anadendrum marginatum Schott, Oestr. Bot. Wochenbl. (1857) 116; Hk.f., F.B.I. 6 (1894) 540; Ridl., Fl. 5 (1925) 116; Henders., J. Mal. Br. R. As. 17 (1939) 83.

Anadendrum montanum Schott, Bonplandia 5 (1857) 45; Hk.f., F.B.I. 6 (1894) 540; Ridl., Fl. 5 (1925) 115; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 83.

Arisaema fimbriatum Mast., Gard. Chron. 2 (1884)) 680; Hk.f., F.B.I. 6 (1894) 502; Ridl., Fl. 5 (1925) 89; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 83.

Tuberous. Leaves 2, petioles 15-25 cm long. Spathe to 15 cm, the free part bent forwards.

Distributed in peninsular Thailand; in Malaya, apparently restricted to limestone; not uncommon, in partly shaded to fairly exposed situations.

Arisaema roxburghii Kunth., Enum. 2 (1837) 18; Hk.f., F.B.I. 6 (1894) 497; Ridl., Fl. 5 (1925) 88; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 83.

Colocasia esculenta (L.) Schott, in Schott & Endlicher, Melet. Bot. 1 (1832) 18.
C. antiquorum Schott, in Schott & Endlicher, Melet. Bot. 1 (1832) 18; Hk.f., F.B.I. 6 (1894) 523; Ridl., Fl. 5 (1925) 96.

Distributed throughout the hot tropics; often cultivated; preferring moist ground. Once collected from limestone under shade, probably an escape from nearby farms (Gunong Ginting, Perak, *Mahmud* s.n.).

Colocasia gigantea (Bl.) Hk.f., F.B.I. 6 (1894) 524; Ridl., Fl. 5 (1923) 96; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 84.

A common species, locally abundant by forest fringes and on limestone; tolerates extreme exposure, but does best under light shade in places with accumulation of some soil and organic debris. In 1970 on Gua Musang, Kelantan it was observed as a pioneer, after fire had destroyed the original vegetation.

Cryptocoryne affinis N.E. Br., in Hk.f., F.B.I. 6 (1894) 494; Ridl., Fl. 5 (1925) 87.

Endemic to Malaya, locally abundant, forming mats on gravelly, shallow stream beds. Once collected growing on limestone debris mixed with much non-calcareous gravel on a shallow stream bed. (Sungei Merapoh, Pahang, *Chin 1480).*

Cryptocoryne minima Ridl., J. Str. Br. R. As. Soc. 54 (1910) 61; Fl. 5 (1925) 88.

A rare endemic previously only known from Tapah, Perak (Ridley, l.c.), rooted in mud. Recently collected from Kelantan, rooted on limestone on the bed of a shallow stream (Gua Batu Boh, Kelantan, *UNESCO 279*).

Cryptocoryne purpurea Ridl., J. Str. Br. R. As. Soc. 46 (1905) 44, Fl. 5 (1925) 87.

Endemic, found in slow forest streams in Johore. Now known from Kelantan, growing on limestone rocks on a shallow stream bed (Gua Panjang, Kelantan, *UNESCO 607*).

Cyrtosperma lasioides Griff., Itin. Not. 3 (1851) 149; Hk.f., F.B.I. 6 (1894) 551.

A plant of open swampy places. Recorded once from limestone, at the base of Kota Glanggi. *(Henderson 22506).*

Epipremnopsis media Engl., Pflanz., 4. 23b (1908) 1; Ridl., Fl. 5 (1925) 120; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 84.
Anadendrum medium Schott in Hk.f., F.B.I. 6 (1894) 540.

Epipremnum giganteum Schott, Bonplandia, 5 (1857) 45; Hk.f., F.B.I. 6 (1894) 548; Ridl., Fl. 5 (1925) 119; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 84.
Raphidophora gigantea Ridl., Mat. 3 (1907) 44.

Hapaline brownii Hk.f., F.B.I. 6 (1894) 521; Ridl., Fl. 5 (1925) 96; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 84.

Plant with a small tuber. Petiole to about 18 cm long, blade ovate-cordate, bullate; margin undulate. Spathe about 7 cm long.

Distributed in peninsular Thailand and Malaya. Restricted to the limestone field; recorded from Kedah and Kelantan only.

Homalomena deltoidea Hk.f., F.B.I. 6 (1894) 536; Ridl., Fl. 5 (1925) 105.

Endemic, found in the forest of Johore, Perak and Kelantan; recorded from limestone in Johore and Kelantan. A plant of shady places.

Homalomena griffithii Hk.f., F.B.I. 6 (1894) 534; Ridl., Fl. 5 (1925) 106; Furt., Gards. Bull. S.S. 10 (1939) 194.

Homalomena humilis (Jack) Hk.f., var. *pumila* (Hk.f.) Furt., Gard. Bull. S. S. 10 (1939) 203; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 84.
H. johorensis Engl., Ridl., Fl. 5 (1925) 106.
H. pumila Hk.f., F.B.I. 6 (1894) 535.
H. purpurascens var. *pumila* (Hk.f.) Ridl., Fl. 5 (1925) 105.

Homalomena rubra Hassk., Decad. (1842) 60; Furt., Gard. Bull. S.S. 10 (1925) 218.
H. coerulescens Jungh. ex Schott, Hk.f., F.B.I. 6 (1893) 218; Ridl., Fl. 5 (1925) 104.
H. singaporensis Regel., in Ridl., Fl. 5 (1925) 110.

Lasia aculeata Lour. Fl. Cochinch. (1790) 81; Ridl., Fl. 5 (1925) 125.
L. heterophylla Schott, Hk.f., F.B.I. 6 (1894) 550.
L. spinosa Thw., Enum. (1864) 336; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 84.

A plant of wet marshy areas which has been found growing in the more sheltered localities at hill bases on limestone.

Pothos latifolius Hk.f., F.B.I. 6 (1894) 554; Ridl., Fl. 5 (1925) 129.
P. maingayi Hk.f., l.c. 554.
P. kunstleri Hk.f., l.c. 554.

Endemic to Malaya; not uncommon in the lowland forest, with one record from limestone, climbing over rocks (*Furtado* s.n. 4th June 1937 from Gunong Baling, Kedah).

Pothos lorispatha Ridl., J. Str. Br. R. As. Soc. 86 (1922) 310, Fl. 5 (1925) 130; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 84.

A slender climber, leaves lanceolate, to 30 cm long. Spathe to 10 cm long. Spadix slender, cylindric.

Endemic to limestone and recorded only from Gua Batu in Selangor.

Pothos macrocephalus Scort. ex Hk.f., F.B.I. 6 (1894) 553; Ridl., Fl. 5 (1925) 128; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 84.

Stem long-climbing, slender, to 0.5 cm in diameter. Leaves lanceolate, broader than petiole. Spathe ovate, to 1.5 cm long; spadix stipitate, globose.

Endemic to Malaya and common on limestone, climbing over rocks and trees. (Gunong Baling, Kedah, *Furtado* s.n.).

Pothos scandens L., Sp. Pl. (1753) 968; Hk.f., F.B.I. 6 (1894) 551; Ridl., Fl. 5 (1925) 127; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 84.

Collected several times from limestone; not as common as *P. macrocephalus*.

Raphidophora beccarii Engl., Bot. Jahrb. 1 (1881) 181; Hk.f., F.B.I. 6 (1894) 546; Ridl., Fl. 5 (1925) 124.

Raphidophora korthalsii Schott, Ann. Mus. Bot. Lugd.-Bat. 1 (1863) 129; Hk.f., F.B.I. 6 (1894) 548; Ridl., Fl. 5 (1925) 124.

Raphidophora kunstleri Hk.f., F.B.I. 6 (1894) 546; Ridl., Fl. 5 (1925) 123.

Stem thick: 7-10 cm in diameter; leaves oblong-lanceolate 20-35 cm long. Spathe long, 15-20 cm, cylindric.

This is an endemic species. The type specimen was collected from Larut, Perak and quoted by Ridley as from between 1500 and 2500 m. This must be a mistake as the hills there do not rise beyond 1500 m. Apart from this, all other collections of this species are from limestone and restricted to Perak.

Raphidophora maingayi Hk.f., F.B.I. 6 (1894) 543; Ridl., Fl. 5 (1925) 123; Furt., Gard. Bull. S.S. 8 (1935) 153; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 84.

Endemic to Malaya; not uncommon in forests, recorded from limestone in Selangor and Johore.

Raphidophora silvestris (Bl.) Engl. in DC., Monogr. Phan. 2 (1879) 239; Furt., Gard. Bull. S.S. 8 (1935) 156.
R. wrayi Hk.f., F.B.I. 6 (1893) 544; Ridl., Fl. 5 (1925) 122.

A species usually found in the hills above 1000 m. Recorded from limestone on Gua Batu, Selangor *(Ridley s.n., Dec. 1896 & Nur 8965)*.

Schismatoglottis calyptrata Zoll. & Morr., Syst. Verz. Ind. Archip. (1854) 83; Ridl., Fl. 5 (1925) 111.
S. longipes Miq., Hk.f., F.B.I. 6 (1894) 538.

Schismatoglottis mutata Hk.f., F.B.I. 6 (1894) 538; Ridl., Fl. 5 (1925) 111; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 84.

Endemic to Malaya, found in lowland forests and on limestone, rare. The limestone records are from Gua Batu, Selangor and Pahang.

Scindapsus hederaceus Schott, Bonplandia, 5 (1857) 45; Hk.f., F.B.I. 6 (1894) 542; Ridl., Fl. 5 (1925) 117.

Scindapsus perakensis Hk.f., F.B.I. 6 (1894) 542; Ridl., Fl. 5 (1925) 118; Furt., Gard. Bull. S.S. 8 (1935) 157; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 84.

Scindapsus scortechinii Hk.f., F.B.I. 6 (1894) 541; Ridl., Fl. 5 (1925) 117.

Usually found above 900 m. Once collected from limestone at an elevation of 200 m (Gua Serai, Kelantan, *UNESCO 437*).

Typhonium filiforme Ridl., J. Str. Br. R. As. Soc. 41 (1905) 45, Fl. 5 (1925) 91; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 84.

Plant with a small tuber. Leaves 2-3, sagitate, 5-8 cm long. Spadix with a long appendage.

Rare, endemic to limestone. Recorded from Perak and Perlis; the Perlis specimen is tentatively identified as this. Known only from these two collections *(Henderson:* Kuala Dipang, Perak, *9620* and Bukit Lagi, Perlis, *22824).*

Typhonium fultum Ridl., J. Str. Br. R. As. Soc. 41 (1905) 45; Fl. 5 (1925) 91; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 84.

Plant nontuberous; leaves ovate-cordate to sagitate, 5-7 by 5 cm. Spadix as long as the spathe.

Rare, endemic to the limestone. Recorded from Langkawi, Selangor and Pahang in shady moist localities.

Dubious record

Homalomena argentea Ridl., J. Bot. 49 (1902) 35, Fl. 5 (1925) 107; Furt., Gard. Bull. S.S. 10 (1939) 186.

A small plant, stem about 2 cm long. Petioles pinkish red, leaves elliptic. Spathe 1.2-1.3 cm long, spadix slightly shorter.

A rare endemic found in the South of Malaya, previously recorded only from Malacca, now known from Johore *(Chin 648),* growing in a small pocket of soil on a small limestone outcrop. This soil appears to be derived from sandstone and is not of calcareous origin.

BURMANNIACEAE

1. Ovary uni-loculate; placentation parietal, flowers pale violet ..... *Gymnosiphon aphyllus*
   Ovary tri-loculate; placentation axile, flowers white 2

2. Perianth tube winged, flowers numerous ..... *Burmannia lutescens*
   Perianth tube not winged, flowers 4-5 ..... *Burmannia championii*

Burmannia championii Thw., Enum. Pl. Zeyl. 5 (1864) 325; Hk.f., F.B.I. 5 (1893) 666; Ridl., Fl. 4 (1924) 306; Jonker, Fl. Mal. I, 4 (1948) 17.

Rare and known from only 3 records in Malaya. The first (*Ridley,* l.c.) was from Selangor forest by the Labu River; "in damp woods deeply buried in decaying leaves." (This record is not noted by Jonker l.c.). Recently this species has been collected over limestone, in shady hollows with rich humus, in Kelantan *(UNESCO 50)* and Selangor *(Chin 1829).* I collected the Selangor specimen in flower on 23rd July 1972; in November 1972, I saw no flowering shoots above ground level. This periodic appearance of above-ground parts and the relatively inconspicuous plant body have probably played an important part in the apparent rarity of this species.

Burmannia lutescens Becc., Malesia 1 (1877) 246; Jonker, Fl. Mal. 1, 4 (1948) 19.
B. gracilis Ridl., J. Str. Br. As. Soc. 22 (1890) 335, Fl. 4 (1924) 305; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 74.

Gymnosiphon aphyllus Bl., Enum. Pl. Jav. 1 (1827) 29. Ridl., Fl. 4 (1924) 306; Jonker, Fl. Mal. I, 4 (1928) 20.

Throughout the lowland forests but uncommon. Recorded from over limestone once (Batu Hayan, Kelantan, *UNESCO 73*).

NOTE

BUTOMACEAE

Limnocharis flava (L.) Buchenau.

Native of tropical America, now naturalised and common in SE. Asia; in wet places. Recorded from Lenggong, Perak, near padi fields, growing in streams underlain by limestone.

COMMELINACEAE

1. Inflorescence terminal 2
   Inflorescence axillary 7

2. Plant a small slender creeping herb to 20 cm tall. Fruits, dehiscent capsules, not blue. Rare on limestone and recorded only from Langkawi 3
   Plant larger, often erect to 60 cm or more tall (except for *Pollia sumatrana* which is ±30 cm tall but which is densely rusty-red pubescent). Fruits indehiscent, blue. Uncommon on limestone and not recorded from Langkawi 4

3. Leaves pubescent beneath; ovary with a single locule and ovule. Very rare, recorded from Malaya only once; on limestone in Langkawi ..... *Aneilema subovatum*
   Leaves not pubescent beneath; ovary with 3 locules and 3-6 ovules. Common weed, recorded from limestone in Langkawi ..... *Aneilema nudiflorum*

4. Inflorescence with flowers densely clustered in heads, leaves 25-40 by 7-10 cm. *Pollia thyrsiflora*
   Inflorescence with flowers spaced out; not in heads 5

5. Inflorescence with peduncle, 4-9 cm long; flowers few. From Perak and the North 6
   Inflorescence with peduncle, 13-20 cm long; flowers numerous. Recorded only from Kelantan ..... *Pollia sorzogonensis*

6. Leaves pubescent beneath; sepals pubescent. Inflorescence to ± 5 cm long. Very rare, recorded from limestone only in Perak ..... *Pollia sumatrana*
   Leaves glabrous beneath, sepals glabrous. Inflorescence ± 8 cm long. Recorded from limestone in Kedah ..... *Pollia subumbellata*

7. Stem herbaceous, succulent, erect, short or to 30 cm tall; leaves linear lanceolate. Inflorescence subtended by spathe-like leafy bract. An escape from cultivation ..... *Rhoeo spathacea*
   stem semi-woody, creeping ascending, to 100 cm long; leaves broadly elliptic. Inflorescence not subtended by leafy bract ..... *Forrestia monosperma*

Aneilema nudiflorum Br., Prodr. (1810) 271; Ridl., Fl. 4 (1924) 355.

A common and widely distributed weed in waste ground and on sandy places. Collected once, growing from limestone crevices. (Kuah, Langkawi *Samat 3).*

Forrestia monosperma Cl., Bull. Herb. Boiss. 6 (1898) 359; Ridl., Fl. 4 (1924) 360.

Endemic to Malaya; found in rocky forests, in moist places under shade. Recorded from limestone in Kelantan and Pahang.

Pollia sorzogonensis Endl., Gen. P1. 13 (1840) 1029; Ridl., Fl. 4 (1924) 350.

Pollia subumbellata Cl., J. Linn. Soc. Bot. 9 (1866) 451; Ridl., Fl. 4 (1924) 350; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 82.

Herb, stem ascending to 90 cm. Leaves thin, glabrous, 8-10 by 2.5 cm. Inflorescence with a 5-cm peduncle, the whole about 9 cm long.

Distributed in the eastern Himalayas and Burma. Confined to the limestone of Kedah and Perlis in Malaya, except (according to Henderson l.c.) for a doubtful specimen from Tembeling in Pahang.

Pollia sumatrana Hassk., Commel. Ind. (1870) 57; Ridl., Fl. 4 (1924) 350.
Very rare in Malaya, once from limestone. (Gunong Pondok, Perak, *Burkill & Haniff, 13907).*

Pollia thyrsiflora Endl., Gen. Pl. 13 (1840) 1029; Ridl., Fl. 3 (1924) 350; Henders., J. Mal. Br. R. As. Soc. 17 (1979) 82.

Rhoeo spathacea (Sw.) Stearn, Baileya 5 (1957) 198; Stone, Micronesica 6 (1970) 105.
R. discolor (L'Heritier) Hance, Ann. Bot. Syst. 3 (1852) 660.

This plant, a native of Central America, is commonly found cultivated in gardens in Malaya. Recently it has been found growing abundantly on one of the western cliff faces on Gunong Rapat in Perak. The plants were growing from cracks and crevices on the ground and up the cliff face. These probably originate from nearby Chinese gardens where they are cultivated for use in local medicine.

Dubious record

Aneilema subovatum Ridl., Fl. 4 (1924) 357; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 82.

Uncommon, recorded only from Langkawi and Perlis. According to Henderson l.c., a doubtfully determined specimen *(Henderson 22822)* is from limestone in Langkawi.

CYPERACEAE

1. Flowers bisexual 2
   Flowers unisexual, female flowers usually below the male 8

2. Inflorescence always subtended by a whorl of leaflike bracts; bracts more than 5 cm long, narrow, the inflorescence then a single head of spikelets or wide: ± 1 cm, then inflorescence an umbel with many unequal radiating branches. Styles persistent and not thickened at the base 3
   Inflorescence not always subtended by a whorl of leaflike bracts; bracts usually < 5 cm long. Inflorescence not with the above combination of characters. Styles deciduous, thickened at the base and articulated with the nut 4

3. Inflorescence a single head of spikelets at the end of stems. Leaves narrow ..... *Cyperus kyllingia*
   Inflorescence an umbel of many unequal branches. Leaves broader: to 1 cm .... *Cyperus trialatus*

4. Glumes spirally arranged. Plant densely tufted. Inflorescence, an umbel of 4 or 5 branches, each with 1 spike. Central sessile spike present at the base of the umbel *Fimbristylis trichophylla*
   Glumes in 2 raws, distichous; not as pronounced in mature spikelets 5

5. Leaves very narrow: 0.5-1 mm. Glumes densely gland-dotted and nuts smooth or if glumes not gland-dotted then nuts finely striate with faint transverse lines 6
   Leaves wider: 1.5-2.4 mm. Glumes not densely gland-dotted, nuts differently marked or smooth 7

6. Glumes densely gland-dotted; styles hairy at the base; nuts smooth. Plant densely tufted, leaves rigid, tips acute, scabrid at the top ..... *Fimbristylis fuscoides*
   Glumes not gland-dotted; styles glabrous; nuts longitudinally striate. Plant slender, tufted, leaves not rigid. Endemic to the Langkawi limestone ..... *Fimbristylis calcicola*

7. Nuts densely warty; leaves abruptly pointed ..... *Fimbristylis fusca*
   Nuts completely smooth; leaves obtuse. Endemic to Langkawi limestone *Fimbristylis malayana*

8. Plant with leaves mainly from the base. Carpellate flowers and nuts enclosed by a modified glume (utricle) 9
   Plant with leafy stems. Carpellate flowers and nuts not enclosed by a modified glums 12

9. Inflorescence a narrow oblong panicle, occupying the upper third of stem. Stems 60-120 cm tall ..... *Carex perakensis*
   Inflorescence not a panicle. Stems usually much shorter: 4-55 cm tall 10

10. Spikes forming ovoid or globose heads, 0.5-1 cm long by 0.8-1.5 cm broad. Leaves very few, 0.2-0.6 cm wide ..... *Carex malaccensis*
    Spikes not forming heads; leaves numerous 11

11. Spikes 1-3, singly at nodes, well spaced mixed (androgynous), female below and male above ..... *Carex speciosa*
    Spikes 5-7; spaced or sometimes close together; rarely to 20 through branching. Terminal: male, remainder: female or mixed ..... *Carex breviscapra*

12. Plant slender, stem 0.1-0.2 cm thick, less than 60 cm tall. Leaves singly on stems ..... *Scleria lithosperma*
    Plant fairly stout, stem ± 0.5 cm thick, and ± 100 cm tall. Upper leaves in groups of 2-6, about 5 cm apart ..... *Scleria multifoliata*

Carex breviscapa C.B. Cl., in Hk.f., F.B.I. 6 (1894) 736; Nelmes, Reinw. 1 (1961) 369.
C. curtisii Ridl., Fl. 5 (1925) 183.

Very rare in Malaya. Known from two collections (non-limestone). A further recent collection from Batu Hayan, Kelantan *(UNESCO 56)* is referred to this species with some doubts.

Carex malaccensis C.B. Cl., in Hk.f., F.B.I. 6 (1894) 722; Nelmes, Reinw. 1 (1951) 257; Ridl., Fl. 5 (1925) 183; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 85.

Tufted. Stem to 50 cm tall, slender. Leaves few, 2-6 mm wide. Inflorescences of 1-4 crowded sessile spikes, each forming subglobose or ovoid heads, whitish; bracteoles aristate.

Endemic to the limestone in Langkawi, not uncommon in partially sheltered localities, growing from rock crevices and on soil.

Carex perakensis C.B. Cl., in Hk. f., F.B.I. 6 (1894) 720; Nelmes, Reiw. 1 (1951) 253; Ridl., Fl. 5 (1925) 184.

Carex speciosa Kunth., Enum. Pl. 2 (1837) 504; Nelmes, Reinw. (1951) 390.

Tufted. Stems slender, 5-50 cm tall, 0.5-1.5 mm thick. Leaves numerous, longer than stems, 3-11 mm wide. Inflorescence with 1-3 spikes well spaced out on the stem, singly from nodes. Each 1-4 cm long, with female flowers in the lower half and male flowers in the upper. Utricles trigonous, ventral face wider than each half of the angled dorsal face.

A new record for Malaya. Distributed in Sumatra and Java. In Java this species has been extensively and frequently collected from calcareous marl. Found in the lowlands and up the hills to more than 1000 m. The Malayan records are all from limestone and so far only from Kelantan and Pahang. It is not an uncommon plant on the Kelantan limestone. Two numbers, *Chin 436* and *1378* are referred to this species with some doubt: their spikes are longer, to 7 cm, and they bear leaves towards the narrow range of its variation, being 3-4 mm wide; in these respects more like *C. stenura* Nelmes which is a rare endemic in the southern division of Borneo. Apparently *C. speciosa* Kunth and *C. stenura* Nelmes, which are the only two species in section Radicales Nelmes, are very similar. Further, Nelmes l.c., has also stated that *C. speciosa* is very polymorphic throughout its range, so perhaps examination of plants from its former geographical range and of recent collections from its new distributional extension would throw additional light on the taxonomy of the section Radicales.

The Malayan records were material growing from rock crevices which had some accumulation of dark red calcareous soil, under partially sheltered conditions. All were from less than 250 m elevation: Gua Serai, Kelantan *UNESCO 314;* Gua Panjang, *UNESCO 508* & Gua Musang, *Chin 1378;* Pahang; Bukit Chintamani, *Chin 436.*

Cyperus kyllingia Endl., Cat. Hort. Acad. Vindob. 1 (1842) 94; Back. & Bakh. f, Fl. Java 3 (1968) 469; Stone, Micronesica 6 (1970) 170.
Kyllingia monocephala Rottb., Desc. Ic. Rar. Pl. (1773), 13, t. 4, f. 4; Ridl., Fl. 5 (1925) 138.

Distributed all over the tropics; in Malaya a common weed of wayside and waste ground, tolerating extreme exposure and poor soils. Once recorded from limestone, (Gunong Rapat, Perak, *Molesworth-Allen 4271.*).

Cyperus trialatus (Boeck.) Kern., Reinw. 3 (1954) 32.
C. bancanus Miq., Ridl., Fl. 5 (1925) 143.
C. turgidulus C.B. Cl. ex Hk. f., F.B.I. 6 (1893) 601.

Fimbristylis calcicola Kern, Blumea 8 (1955) 129, ibid., 15 (1967) 439.

Tufted. Stems very slender, to 20 cm tall. Leaves 0.5-1 mm wide. Inflorescence with 3-9 spikelets, bracts setaceous. Nut oblong-ovoid, ± 0.6 mm long.

Endemic to the limestone on Pulau Langkawi and so for known only from a single collection (*Corner* s.n. 19th Nov. 1941).

Fimbristylis fusca (Nees) C.B. Cl., F.B.I. 6 (1893) 649; Kern, Blumea 15 (1967) 435.

Fimbristylis fuscoides C.B. Cl., Kew Bull. add. ser. 8 (1908) 25; Ridl., Fl. 5 (1925) 160; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 86.

Rare in Malaya and only known from Langkawi and Perlis. The Perlis specimens are from open 'heath' country (not limestone), and according to Henderson l.c. the ones in Langkawi are from limestone.

Fimbristylis malayana Ohwi, Blumea 8 (1955) 96; Kern, Blumea 15 (1967) 438.

Tufted. Stems slender, 20-40 cm tall. Leaves much shorter than the stems, tips obtuse, 1.5-2 mm wide. Inflorescence simple sub-compound, with 2-7 spikelets. Spikelets 8-10 by 2-2.5 mm. Nut smooth, obovoid.

Endemic in Pulau Langkawi, on the limestone, known only from 3 collections.

Fimbristylis trichophylla Ridl., Fl. 5 (1925) 155; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 86.

Tufted. Stems slender, 15-30 cm tall, leaves slightly shorter, filiform linear. Inflorescence an umbel of 4-5 branches, each with 1 spike, and a sessile spike in the centre of the umbel. Spike ovate, 0.2 cm long.

Thailand and Malaya. Growing from limestone rock crevices, tolerating rather exposed conditions.

Scleria lithosperma Swartz, Prodr. Veg. Ind. Occ. (1788) 18; Clarke in Hk.f., F.B.I. 6 (1893) 685; Ridl., Fl. 5 (1925) 176; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 86.

Scleria purpurascens Steud., Syn. Pl. Cyp. (1855) 169; Back. & Bakh. f., Fl. Java 3 (1968) 485.
S. multifoliata Boeck. ex Hk. f., F.B.I. 6 (1984) 693; Ridl., Fl. 5 (1925) 178.

DIOSCOREACEAE

1. Stems twining to the left, the tip growing in a clockwise direction; the stem with a clockwise twist 2
   Stems twining to the right, the tip growing in an anti-clockwise direction; the stem with an anti-clockwise twist 6

2. Leaves compound; 3-foliolate, middle leaflet largest, to 30 by 28 cm ..... *Dioscorea hispida*
   Leaves simple, rarely lobed 3

3. Capsules as broad or broader than long, male flowers with an enlarged torus 4
   Capsules longer than broad, torus of male flowers not enlarged, leaves usually broadly cor date, upper surface slightly bullate ..... *Dioscorea bulbifera*

4. Plant glabrous; inflorescence usually cymose 5
   Plant pubescent with T-shaped hairs; inflorescence usually spicate or racemose ..... *Dioscorea esculenta*

5. Leaves trifid above a cordate base; male flowers in small cymes; capsule wings nearly twice as long as wide ..... *Dioscorea membranacea*
   Leaves not lobed, cordate; male flowers usually solitary; capsule wings 2½ times as long as wide ..... *Dioscorea calcicola*
   Leaves ovate, elliptic or rounded, much more than 1.5 cm wide 7

7. Base of leaves on mature plants narrowed or rounded, not cordate or sagittate, male spikes erect 8
   Base of most leaves on mature plants cordate or sagittate, male spikes horizontal or pendulous 9

8. Leaves coriaceous, lanceolate-ovate to 16 by 5 cm, frequently less ..... *Dioscorea laurifolia*
   Leaves herbaceous, elliptic or ovate-elliptic, to 15 by 7 cm ..... *Dioscorea prainiana*

9. Leaves pubescent, at least on the petioles and the lower surface 10
   Leaves glabrous 11

10. Leaves ovate-elliptic, base slightly cordate; to 11 by 8 cm ..... *Dioscorea pyrifolia*
    Leaves rounded, as broad as long, base cordate, usually 12 by 12 cm, often larger ..... *Dioscorea polyclados*

11. Leaves longer than broad, ±10 by 6 cm; axis of male spikes zig-zag ..... *Dioscorea filiformis*
    Leaves as broad as long, ± 10 by 10 cm; axis of male spikes not zig-zag ..... *Dioscorea glabra*

Dioscorea bulbifera Linn., Sp. Pl. (1753) 1033; Ridl., Fl. 4 (1924) 315; Henders. J. Mal. Br. R. As. Soc. 17 (1939) 81; Burk., Fl. Mal. I, 4 (1951) 311.

Dioscorea calcicola Prain et Burk., Kew Bull. (1925) 64; Ridl., Fl. 5 (1925) 341 Henders., J. Mal. Br. R. As. Soc. 17 (1939) 81; Burk., Fl. Mal. I. 4 (1951), 327.

Slender climber; leaves opposite or alternate, lanceolate-acuminate, base rounded or cordate, to 12 by 1.5 cm. Male spikes from the upper leaf axils.

Distributed in Peninsular Thailand; in Malaya nearly always from limestone; recorded from Langkawi, mainland Kedah and Kelantan. The only non-limestone record is from Kedah Peak.

Dioscorea esculenta (Lour.) Burk., Gard. Bull. S. S. 1 (1917) 396; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 81; Burk., Fl. Mal. I, 4 (1951) 307.
D. aculeata Linn., Ridl., Fl. 4 (1924) 315.

Widely cultivated in Malaya and over most of the tropics. Recorded from limestone in Kedah.

Dioscorea filiformia Bl., En. Pl. Java 1 (1827) 22; Burk., Fl. Mal. I, 4 (1915) 329.
D. gibbiflora Hk.f., F.B.I. 6 (1892) 294; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 81.
D. myriantha Kunth, Henders., J. Mal. Br. R. As. Soc. 17 (1939) 82.

Dioscorea glabra Roxb., Fl. Ind. 3 (1832) 803; Hk.f., F.B.I. 6 (1892) 294; Ridl., Fl. 4 (1924) 318; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 81.

Dioscorea hispida Dennst. in Schluss. Hort. Malab. (1818) 15; Burk., Fl. Mal. I, 4 (1951) 318.
D. triphylla Linn. Ridl., Fl. 4 (1924) 314; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 82.

Dioscorea polyclades Hk.f., F.B.I. 6 (1892) 294; Ridl., Fl. 4 (1924) 315; Burk., Fl. Mal. I, 4 (1951) 334.

Dioscorea prainiana Kunth, Pfl. R. 87 (1924) 286; Burk., Fl. Mal. I, 4 (1951) 324.
D. deflexa Hk.f., F.B.I. 6 (1892) 293.

Dioscorea prazeri Prain et Burk., J. As. Soc. Beng (1904) 73; Burk., Fl. Mal. I, 4 (1951) 307.

Recorded from limestone in Perlis. Referred to by Henderson l.c. as doubtfully *D. membranacea* Pierre ex Prain et Burk.

Dioscorea pyrifolia Kunth, En. Pl. 5 (1850) 384; Hk.f., F.B.I. 6 (1892) 292; Ridl., Fl. 4 (1924) 316; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 82; Burk., Fl. Mal. I, 4 (1951) 332.

Note

Dioscorea membranacea Pierre ex Prain et Burk., J.. As. Soc. Beng 10 (1914) 13; Henders., J. Mal. Br. R. As. Soc. 17 (1939) 81.

The specimen (*Henderson 22884)* doubtfully referred to as this species by Henderson l.c. is actually *D. prazeri* Prain et Burk. (which see).

This species is distributed in Thailand, Burma and Indochina and so far has not been recorded from Malaya.

FLAGELLARIACEAE

Hanguana malayana (Jack) Merr., Philip. J. Sc. 10. (1915) 3; Back. & Bakh f., Fl. Mal. I, 4 (1951) 249.
Susum malayanum (Jack) Pl. ex Hk. f., F.B.I. 6 (1892) 391; Ridl., Fl. 4 (1924) 369.

New and Interesting Plant Records for Singapore

J.F. MAXWELL
Botanic Gardens
Parks & Recreation Department
Singapore

Abstract

Botanical collecting trips in Singapore from 1976 to end 1982 resulted in 5 new records and 15 other taxa which are rare and have not been collected here in recent years. Brief notes on these species, including their collecting localities and overall distribution, are included.

Introduction

Since the publication of Ridley's *Flora of the Malay Peninsula* (Ridley, 1922-25) which includes that of Singapore, only Keng's "Annotated List of Seed Plants of Singapore" (Keng, 1973-82, incomplete) is available. Although the Flora of Singapore is quite well-known and was updated by Sinclair (1953, 1956), I have had the opportunity since 1976 to collect and identify many local plant species — 5 of which have not been previously recorded for Singapore and 15 others which are either rare, flower or fruit infrequently, or have not been collected locally for many years. The information presented here is compiled from my own observations and searches in the herbarium, Botanic Gardens, Singapore. It is anticipated that further collecting in Singapore will result in additions to this paper.

Agavaceae

1. *Dracaena maingayi* Hk. f.

This spectacular tree, the height of which I have seen reaching 25-30 m, is perhaps the tallest species for the genus. Although there are several specimens in the Herbarium, collected in Singapore between 1885-1899 by Hullett, Ridley, and Mat, only a few of these trees at Bukit Timah and Labrador Nature Reserves and one from Bukit Kallang from which I collected fruits, are presently known. *Dracaena maingayi* Hk. f. is also known from Pahang, Perak, Malacca, and Johore. Voucher specimen: *Maxwell 82-75,* 2 Feb. 1982. Plate 1.

Anacardiaceae

2. *Mangifera macrocarpa* Bl. *New Record*

This very interesting species was first brought to my attention by my colleague, Mr. Tay Eng Pin, who noticed it at Bukit Timah Nature Reserve early September 1982. I later went with him and another colleague, Encik Sidek bin Kiah, and found several vegetative juvenile specimens 1-4 m tall along Lower Path (Taban Path) in this forest. Subsequent searches in the Herbarium by Encik Mohd. Shah bin Mohd. Noor revealed the identity of this species. The latter has also been observed in the Labrador Nature Reserve.

Mangifera macrocarpa Bl. is, apparently, a very rare species throughout its range and has been found in Cambodia, peninsular Thailand, W. Malaysia (Kelantan, Trengganu, Pahang, and Malacca), Sumatra, Java, Sabah, Kalimantan, and the Anambas and Nunukan Islands. Almost all of the known collections of this species are vegetative, including the few we have here, and, according to several reports, this species rarely produces flowers and fruits (Hou, 1978). Voucher specimen: *Sidek 607,* 9 Sep. 1982.

Apocynaceae

3. *Epigynum forbesii* King & Gamble *New Record*

Originally described from Sumatran material, this species is also known from a few collections from Sarawak and W. Malaysia (Kemaman and Johore). It was, therefore, surprising to find this species, a woody climber, along the margins of the swamp forest at Nee Soon. So far I have been unable to find other specimens of this rare species at Nee Soon or any other place in Singapore. Voucher specimen: *Maxwell 82-148,* 23 Apr. 1982. Plate 2.

Araceae

4. *Raphidophora sylvestris* (Bl.) Engl. var. *montana* (Bl.) Nicols.

This variety is frequently seen creeping up tree trunks in the evergreen forest at Bukit Timah Nature Reserve and in the swamp forest at Nee Soon. It has been collected at Chua Chu Kang by Goodenough in 1890 and by Ridley at the Bukit Timah Nature Reserve in 1899 and Bukit Panjang in 1905. My collection from the Nee Soon swamp forest is a flowering specimen and is, apparently the most recent addition of flowering/fruiting material to our herbarium since Ridley's collection in 1905. This variety is also found in Perak, Penang, and Malacca. Voucher specimen: *Maxwell 82-149,* 23 Apr. 1982.

Euphorbiaceae

5. *Neoscortechinia kingii* (Hk. f.) Pax & Hoffm. *New Record*

This inconspicuous tree is known from scattered locations throughout W. Malaysia and has often been collected in swamp forests. The first record of this species from Singapore was fruiting material found at the Nee Soon swamp forest in December 1981 by two of my colleagues *(Shah and Ali MS 4157).* I later found fruiting material of this tree in the same area on 17 February 1982 *(Maxwell 82-44)* and female flowers were collected from the same tree on 23 April 1982 *(Maxwell 82-150).* This species is also known from Sarawak and Kalimantan. Plate 3.

Fagaceae

6. *Lithocarpus wallichianus* (Lind. *ex* Hance) Rehd.

Although this species is common in peninsular Thailand and W. Malaysia, it

Plate 1: *Dracaena maingayi* Hk. f., branch full of orange-red fruits. Photo by Mr. Hugh Tan.

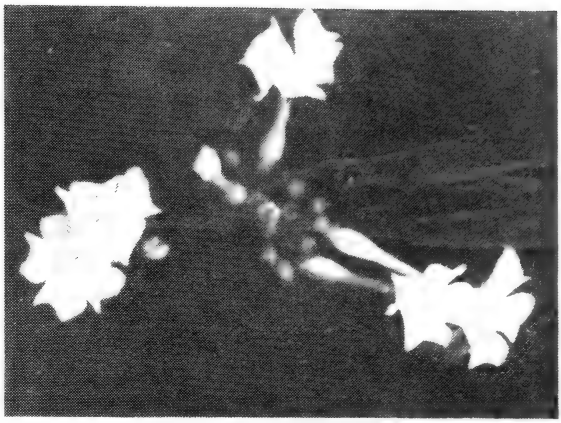


Plate 2: *Epigynum forbesii* K. & G., part of inflorescence showing the cream-coloured corollas. Photo by Mr. Hugh Tan.

Plate 3: *Neoscortechinia kingii* (Hk. f.) Pax & Hoffm., fruiting branches at Nee Soon. Photo by Dr. B..C. Stone, 24 Aug. 1982.

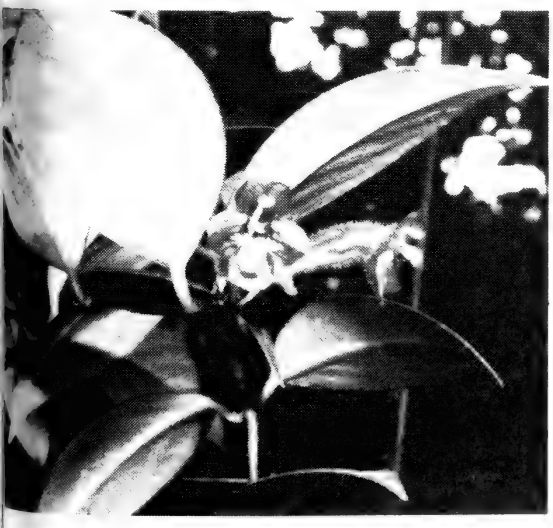


Plate 4: *Aeschynanthus wallichii* R. Br., upper part of plant showing the bright red corolla; photo by Mr. Hugh Tan.

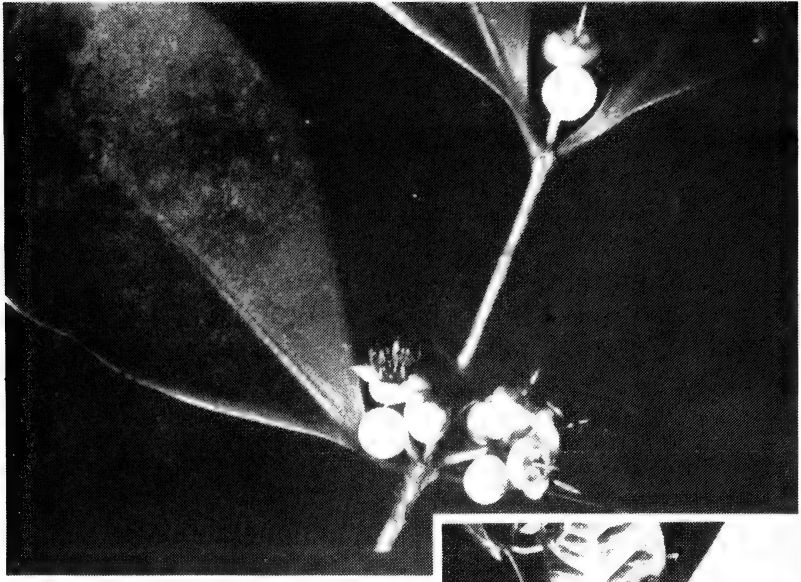


Plate 5: *Memecylon cantleyi* Ridl., showing buds, open flowers, and fertilized flowers where the petals and stamens have fallen off. The white calyces and vivid blue of the petals and filaments, are quite attractive. Photo by Mr. Hugh Tan.

Plate 6: *Memecylon excelsum* Bl., branch with flowers and developing fruits. Photo by Dr. Ivar Polunin.

Plate 7: *Stephania capitata* (Bl.) Spreng., leafless lower stems with inflorescences and with leaves on the upper part. Photo by Dr. B.C. Stone.

has only been collected on a few occasions in Singapore. There are several specimens of this small tree in the herbarium — all collected by Ridley between 1889-1898 from Pulau Ubin, Changi, and Jurong. The material that I collected from Seletar Reservoir, near the Singapore Zoological Gardens on 26 August 1982, is apparently the only other collection of this rare species from Singapore. Voucher specimen: *Maxwell 82-241.*

Gesneriaceae

7. *Aeschynanthus wallichii* R. Br.

The earliest collection we have of this species from Singapore was gathered by Ridley at Kranji in 1889. The few other specimens from Singapore were collected at Chua Chu Kang (Mandai), Bukit Timah forest, and Jurong. Up to now, the most recent collection is from the swamp forest at Nee Soon and was made by Sinclair in 1948. This species is known from Trengganu, Perak, Malacca, and Johore, as well as Sarawak and Sumatra. This is a very rare and colourful species on account of is bright red corolla, and was found by me as a creeping/climbing vine on a tree trunk on 19 March 1982 *(Maxwell 82-80)* in the swamp forest at Nee Soon. Plate 4.

Lauraceae

8. *Litsea lancifolia* (Roxb.) Hk. f.

This understorey tree is known from southern Thailand and W. Malaysia (Perak, Pahang, Kelantan, Selangor, and Johore) where it is, apparently, very rare. The species is in record for Singapore by specimens collected by Mat at Seletar in 1894 and by Ridley at Bukit Panjang in 1900. My specimen was collected on 19 March 1982 in the evergreen/swamp forest at Nee Soon near the Rifle Range. Voucher specimen: *Maxwell 82-78.*

9. *Litsea ridleyi* Gamb.

This species, apparently only known from Singapore, is an understorey tree which has been collected at Changi by Goodenough in 1892 and in the Reservoir woods in 1983, along Holland Road by Hullett in 1893, and at Bukit Mandai by Ridley in 1892 and 1900. It was not until 1976 that another flowering or fruiting collection was made (Shah & Samsuri 3946) followed by a staminate collection which I made on 28 February 1982 *(Maxwell 82-61)* at the Bukit Timah Nature Reserve. This species is undoubtedly very rare and probably can only be found in the Bukit Timah forest and perhaps in the Catchment Area since its other collecting habitats have been destroyed.

Malpighiaceae

10. *Aspidopteris concava* (Wall.) Juss.

This woody climber, known from southern Burma, W. Malaysia (Kedah, Penang, Perak and Malacca) and Sumatra; is known from Singapore by two collections made by Ridley at Bukit Mandai (in 1892, fruits) and at Chua Chu

Kang (in 1894, flowers). The specimens that I collected in the open, disturbed undergrowth bordering the swamp forest at Nee Soon were in flower. I have been unable to find fruits of this very rare species on return visits. Voucher specimen: *Maxwell 82-46,* 17 Feb. 1982.

Melastomataceae

11. *Memecylon cantleyi* Ridl.

This small understorey tree is only known in Singapore from the evergreen forest at the Botanic Gardens, where it was first collected and described by Ridley in 1907. Our herbarium has several collections from the type locality of this species but it wasn't until earlier this year that I was able to collect material in flower (15 March 1982, *Maxwell 82-68)* and in fruit (19 April 1982, *Maxwell 82-139)* of this very rare species and from the same tree. I know of only two individuals of this species here.

Memecylon cantleyi Ridl. is known from Thailand, throughout W. Malaysia, and Simeulöee Island near Sumatra. Plate 5.

12. *Memecylon excelsum* Bl. *New Record*

A single individual of this elegant tree species, one of the tallest in the genus in the Malay Peninsula, was found near Bukit Kallang on 27 August 1981 and has been observed to produce either flowers or fruits throughout most of the year. This species is also known from Nicobar Island, throughout the Malay Peninsula, Simeulöee Island, Mentawai Island (west of Sumatra), Sabah, and Kalimantan. It is well-represented in our herbarium and it seems unusual that it should be so rare in Singapore (Maxwell, 1980). Voucher specimen: *Maxwell 81-202.* Plate 6.

13. *Pachycentria maingayi* (Cl.) Maxw.

This epiphytic shrub, with swollen, myrmecophylous (ant-inhabited) roots has been collected on a few occasions in Singapore by Maingay, Goodenough, and Ridley from Kranji, Bukit Timah forest, and a few other locales. Prior to my collection from the Singapore Zoological Gardens on 28 December 1976, the most recent specimen in the Herbarium was collected by Ridley in 1894 from Chua Chu Kang. Unfortunately, the plant at the zoo has since been destroyed due to "development" of the area. I do not know of any other place in Singapore where this species can be found, it is however, known from many scattered locales throughout W. Malaysia. Voucher specimen: *Maxwell 76-825.*

14. *Sonerila heterostemon* Naud.

Even though I have noticed a few small, immature specimens of this very colourful herb along the streams at the Bukit Timah Nature Reserve, I did not see flowering or fruiting material of this species until 21 October 1982. *Sonerila heterostemon* Naud. is very common throughout the Malay Peninsula and is also known from Sarawak and Sumatra. The plant is readily distinguished by

having six stamens and asymmetric leaf blades which are dark green with whitish dots on the upper surface and pale green with purple veins on the underside. Specimens of this species were collected at Bukit Timah in 1885 (Hullett), 1889 (Ridley), and 1928 (Holttum) as well as at Changi in 1892 (Ridley). My collection *(Maxwell 82-277)* is the most recent of this rare species in Singapore that our herbarium has.

Menispermaceae

15. *Stephania capitata* (Bl.) Spreng.

This inconspicuous and very rare, cauliflorous vine was collected in Singapore on several occasions by Ridley and Goodenough between 1889 and 1905 at Bukit Mandai, Seletar, Chua Chu Kang, and along Sungei Jurong. Apparently, my specimen collected in the Nee Soon swamp forest is the only collection we have from Singapore since 1905. This species is well-represented in our herbarium and is known from southern Thailand, throughout W. Malaysia, Sumatra, Java, Sarawak, Sabah, and the Philippines. Voucher specimen: *Maxwell 82-234,* 24 Aug. 1982. Plate 7.

Myristicaceae

16. *Myristica cinnamomea King.*

Although this tree species is known from throughout the Malay Peninsula, the East Coast of Sumatra, Sarawak, Brunei, Sabah, Kalimantan, and Mindanao; it is very rare in Singapore. The only specimens of this species from Singapore in the Herbarium are four collections (three with flowers and one with fruits) which were gathered by Ridley and Goodenough between 1981 and 1894 from Bukit Mandai, Changi, Sembawang, and Sungei Buloh. The specimens of this species that I collected in the evergreen forest of the Bukit Timah Nature Reserve along the Boundary Path below the Hindhede Hut on 11 November 1982 were in fruit. Voucher specimen: *Maxwell 82-288.*

Piperaceae

17. *Piper malaccense* C. DC. *New Record*

This inconspicuous species, with an erect growth form, was found in the shaded swamp forest at Nee Soon on 29 July 1982 *(Maxwell 82-199).* There are in the Herbarium only a few collections of this apparently uncommon species from Negri Sembilan, Malacca, and Johore. Voucher specimen: *Maxwell 82-199.*

18. *Piper pedicellosum* Wall. *ex* C. DC.

This species was described from material collected in Singapore in 1822 and, apparently, has not been gathered here since. None of the original specimens is at our herbarium but there is material from Perak, Pahang, Selangor, Malacca, and Johore. It is also found in Assam and the Andaman Islands.

Piper pedicellosum is a climbing species and was found in fruit along the margins of the secondary forest at Bukit Kallang on 23 August 1981. Voucher specimen: *Maxwell 81-201.*

Rubiaceae

19. *Hedyotis trinervia* (Retz.) Roem. & Schult.

Ridley collected the only known specimen of this prostrate herb from Singapore at Gelang (Geylang) in 1896. I found this attractive species in an open, sandy area on Pulau Sudong on 28 November 1982. There are in the Herbarium a few collections of this apparently uncommon/rare species from Pahang, Perak, Province Wellesley, Penang, Sabah, and Sarawak; with further distribution in Sri Lanka, India, Sumatra, and Java. Voucher specimen: *Maxwell 82-295.*

Sterculiaceae

20. *Byttneria maingayi* Mast.

A common woody climber in Singapore in the past, as evidenced by the collections made by Cantley, Hullett, Goodenough, and Ridley between 1885 and 1894, this species has not, apparently, been recorded from Singapore since that time. Flowering collections were made at the swamp forest at Nee Soon on 26 February 1982, but fruits were not seen during subsequent visits on any of the plants originally observed. This species is also known from Penang, Malacca, and Johore. Voucher specimen: *Maxwell 82-59.*

References

Hou, Ding (1978). Anacardiaceae in van Steenis, ed. *Flora Malesiana* 8:3, 439-440.

Keng, H. (1973-82). Annotated List of Seed Plants of Singapore, I-VIII. *Gard. Bull. Sing.* 26, 233-237; 27, 67-83 and 247-266; 28, 237-258; 31, 84-113; 33, 84-113; 33, 329-367; and 35, 83-103.

Maxwell, J.F. (1980). Revision of *Memecylon* L. (Melastomataceae) from the Malay Peninsula. *Gard. Bull. Sing,* 33, 31-150.

Ridley, H.N. (1922-25). *Flora of the Malay Peninsula,* 5 vols. London, Reeve & Co.

Sinclair, J. (1953). Additions to the Flora of Singapore and New Localities in Singapore for Some Plants Thought to be Extinct. *Gard. Bull. Sing.* 14, 30-39.
———— (1956). *idem.* Part II. *Gard. Bull. Sing.* 15, 22-30.

The identity, affinities, and staminate floral structure of *Pandanus pendulinus* Martelli (Pandanaceae)

BENJAMIN C. STONE
Department of Botany, University of Malaya, Kuala Lumpur, Malaysia

and

KIM-LANG HUYNH
Botanical Institute, University of Neuchâtel, Switzerland

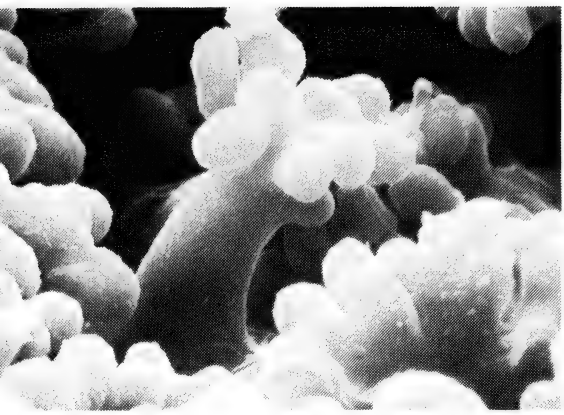
Abstract

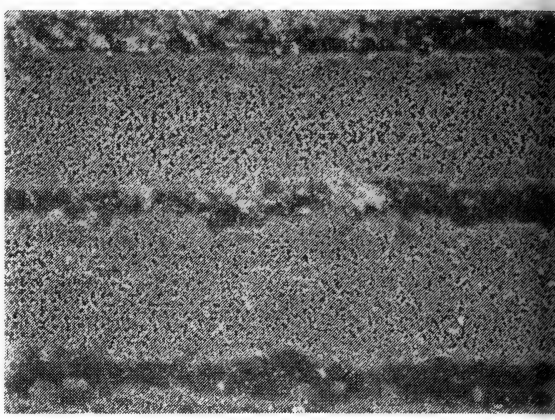
The leaves and male flower of *Pandanus pendulinus*, an obscure species known so far only from one collection (the type), have been studied from both gross and micromorphological viewpoints using both light and scanning electron microscopy. The species, which was originally placed in section *Acrostigma*, is reassigned on the basis of the characters observed, to subgenus *Lophostigma*, but it still remains uncertain in its closer relationships and cannot yet be assigned to a particular section within this subgenus.

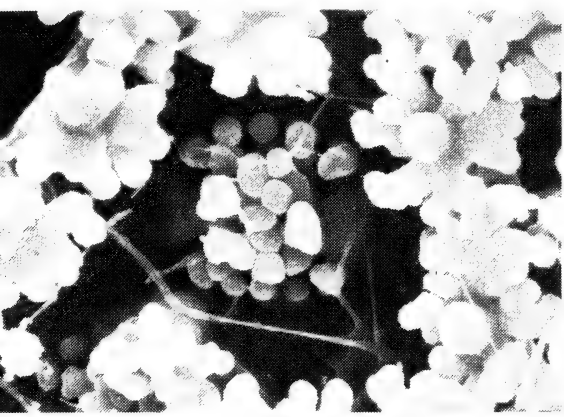
Introduction

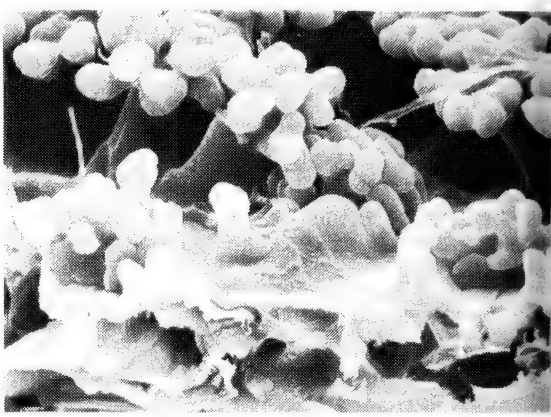
In 1925-26 the Arnold Arboretum sponsored a botanical expedition to New Guinea. The collector was Leonard J. Brass, who continued in later years and became perhaps the most capable, persistent and knowledgeable field botanist ever to have worked in New Guinea. On this early trip, Brass collected chiefly in the Gulf district of Papua, in the region of the Vailala River about 150 miles north-west of Port Moresby, and also in the Laloki River area along the coast between Port Moresby and Redscan Bay. C.T. White, the government botanist in Brisbane, undertook the identification of the materials collected, assisted by various specialists, and the Pandanaceae were consigned for study to the then authority, U. Martelli. In his report, Martelli (1929) described six new species of *Pandanus* from the collections made by Brass. All but one of these have subsequently been collected again, if only once or twice. One of them, however, *Pandanus pendulinus,* has never again been collected.

During 1971 when the senior author (B.C.S.) was studying the New Guinea pandans in the field through the courtesy of the Lae Herbarium, the opportunity was taken to work around Ihu, on the Vailala River, in the hope of obtaining this and other species in the area originally explored by Brass. During this visit many collections were made and one new species *(Pandanus columbiformis)* was discovered (Stone 1974a). Three of Martelli's species were recollected *(Pandanus leptocarpus, P. scabribracteatus,* both from Ihu, and *P. brassii,* from another locality), but *P. pendulinus* was not found and is still known only from the original type collection.









Plates 1-4, *Pandanus pendulinus:* 1 *(top left)* — leaf, papilla of polar cell from abaxial face, with lobulate apex at centre, x 2263; 2 *(top right)* — leaf, abaxial face (the darker, narrower bands are the non-stomatiferous zones, x 31); 3 *(bottom left)* — leaf, abaxial face (in centre stomate with branched apices of papillae of polar cell, flanked by a lateral cell revealed by its five simple papillae; in periphery, dentritic papillae from neighbouring cells forming a "roof", x 1293); 4 *(bottom right)* — leaf, transverse section, abaxial side (in right-hand third, epidermis and hypodermis, with two transversely cut stomata respectively at top and bottom, each with guard cells, lateral cells with simple papillae, and at left the branched apex of papilla from polar cell; in left side two-thirds, abaxial face with lobulate papillae of non-stomatic epidermal cells, x 1422).

Thus *Pandanus pendulinus* has remained an enigma, particularly because the sole collection was a staminate flowering specimen, with the spikes and flowers in a meagre and rather poor state of preservation, and with inadequate materials of the vegetative parts. Martelli (1929) assigned this species to section *Acrostigma.* However, his description of the stamens as separately standing on bulbils of the spike axis and with "filamento longissimo, tenuissimo, 2.5 mm longo" reveals that there could be no affinity with this or any other section of subgenus *Acrostigma.*

An examination of the type specimen, preserved in the herbaria of the Arnold Arboretum of Harvard University and the Botanical Institute of the University of Firenze, showed that the spikes were heavily damaged and most stamens broken, only a few anthers being found still bearing the apiculus. Luckily a few intact stamens still attached to the spike axis were found, these permitting a more complete understanding of their structure. Tangential microtome sections of portions of the spike made it possible also to ascertain the arrangement of the stamens, and thus the identification of the floral unit on the spike axis. Anatomy of the stamens as well as of the leaf was investigated. For a better comprehension of the taxonomic value of leaf micromorphology, see Huynh (1974).

Description of the species

Pandanus pendulinus Martelli, J. Arn. Arb. 10: 142, pl. 18B, 1929. Kanehira, Bot. Mag. Tokyo 54: 258. 1940.

A tree 7-8 m tall, the trunk spiny, 20 cm in diameter, at base with proproots to 3 m long, 5 cm thick, stilt-like, fibrous, densely spiny with antrorse spines. Leaves broadly linear, 300-350 cm long or more, to 11.5 cm wide, gradually attenuate and slightly acuminate toward the apex, there almost flat but toward the base deeply channelled, thickly and rigidly coriaceous, the undersurface glaucescent, the longitudinal veins scarcely to somewhat prominent, smoother than the inter-vein bands (zonate). Leaf margins prickly; toward the base ... (no data); above the base but below the middle, with prickles 1.5-2 mm long, 4-9 mm apart, all antrorse, the prickle-base broad, its distal edge straight and perpendicular to the leaf-margin, at apex abruptly deflected forward as a dark, sharp tip; near the leaf middle, the marginal prickles 1-1.4 mm long, 5-11 mm apart, antrorse; near the apex, the prickles more appressed, more deltoid, 0.5-1 mm long, 1-3 mm apart. Midrib dorsally carinate, acute, near the base ... (no data); above base but below middle, with very small antrorse depressed prickles 0.25-0.4 mm long, 2-8 mm apart; near but below the apex, the prickles yet smaller and more appressed; along apex, the prickles absent or reduced to minute nubs less than 0.1 mm high, blunt. Apical ventral pleats of leaf rounded, unarmed in our scanty material. Longitudinal nerves about 150 per leaf, 0.4 mm apart nearest margins, to 1.1 mm apart near the midrib, light brown. *In microscope:* abaxial epidermis divided into broad stomatiferous zones and very narrow non-stomatiferous zones, stomates about 18 μ long, of class VII (polar cells each with an apically dendritic papilla), papillae of polar cells c. 16 μ long; lateral cells with 5 or 6 simple papillae in line, nonstomatic cells each with a dendritic (Class VII) or branched or lobed (Class VI) papilla, the latter about 15 μ in diameter; chlorenchyma (on both sides) almost uninterrupted at the longitudinal

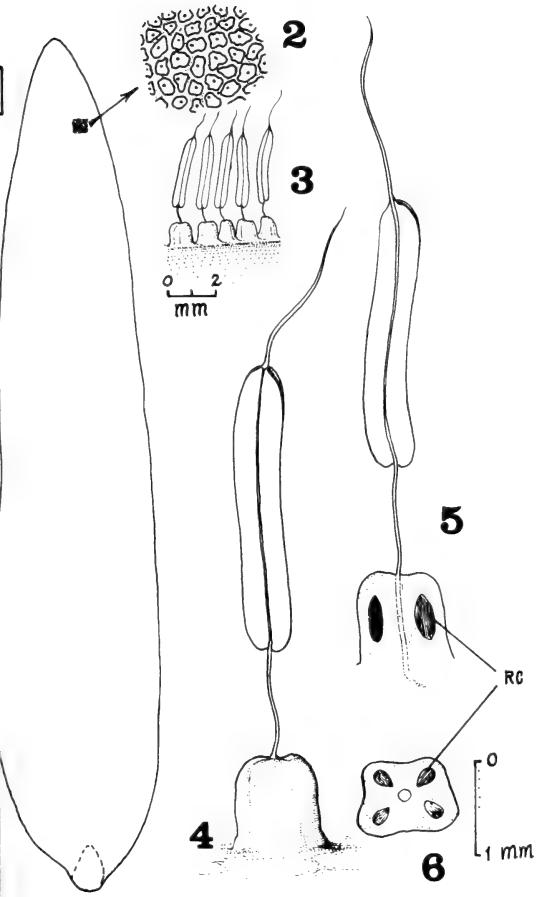
nerves, hypodermis with 3 or 4 cell-layers, spongy tissue with 0 or 1 cell-layer; first cell-layer of hypodermis with crystal cells in both sides, but these most dense at the longitudinal nerves in the abaxial side. (Plates 1, 2, 3 & 4).

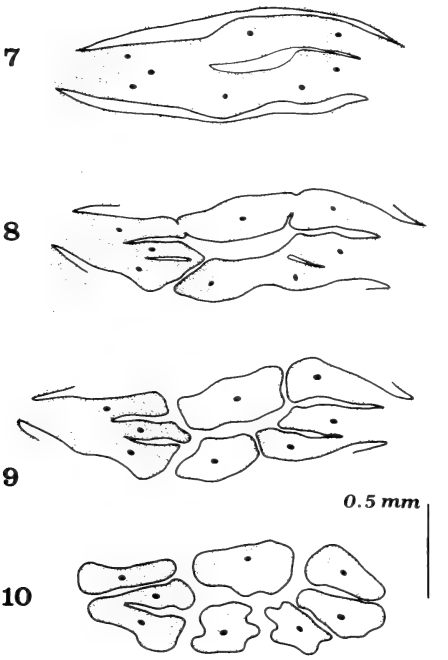
Staminate inflorescence pendulous, over 1 m long, with many narrow spathes; main rachis to 3 cm diameter; upper internodes 7 cm long or less; lower spathes over 50 cm long, over 3 cm wide; lanceolate; upper spathes linear-lanceolate, gradually acuminate, navicular, narrow, coriaceous, margins apparently (distally) minutely prickly; apical ventral pleats with a few prickles; coloration red. Spikes 5-7, up to 20 cm long, 4 cm broad at base, narrowed to apex, somewhat flattened, covered with the very numerous crowded stamens, subsessile. Stamens arranged in floral units of elliptical form consisting of 7 to 9 stamens without a column, each stamen with a bulbilliform filament (brown in our material) about 1 mm long and 1 mm broad, rounded at the apex, variously subangular in section, connate at base, with a single vascular bundle and 3-5 raphid cells around it; anthers c. 3 mm long, 0.5 mm wide, oblong, rounded at base and apex, 2-celled when mature, linked to the filament by an extremely slender basal prolongation of the connective about 2.5 mm long, about 0.05 mm thick, smooth translucent, devoid of both raphid cells and crystal cells and without endothecial sclerification; walls of loculi devoid of both raphid cells and crystal cells, completely opened at full dehiscence, with an endothecium generally 2-layered at the middle and an extremely thin epidermis with elongate cells; connective endothecially sclerified throughout except for a thin portion around the vascular bundle, devoid of raphid cells and crystal cells or rarely with 1 or 2 raphid cells; apiculus flagelliform, to 2.5 mm long, 0.05 mm thick, smooth translucent, vascularized in the lower half, endothecially sclerified very slightly at base, with 1 or rarely 2 raphid cells; pollen smooth, about 17 x 12 x 10μ, pore apical, tectum complete. (Figs 1-6).

PAPUA NEW GUINEA: Ihu, on the Vailala River, 24 February 1926, *L. J. Brass 1053* (A! holotype, FI! isotype).

Observations on the structure of the staminate flower

When observed from above, the stamens of *P. pendulinus* appear to be free on the spike axis. However, serial tangential sections reveal that they are arranged in distinct floral units, which we presume to be the staminate flowers. In the lowermost sections, vascular bundles are horizontal and belong to the spike axis. From sections close to the surface of the spike axis, all vascular bundles appear distinct and vertical and belong to the staminate flowers. In the next section above, several gaps more or less parallel with the spike axis appear, each marking a lateral boundary of the flower. In the next higher section these gaps are wider; and shorter gaps, more or less parallel with them, occur between them. Thus there is a more or less elliptic uninterrupted structure with 7 to 9 vascular bundles (Fig. 7, where 8 such bundles are visible); this is formed by the connate bases of the filaments of a single floral unit. In the next section above, the filaments appear between radial gaps in the elliptical area (Figs. 8-10). The filaments are variously connate basally, but become separate at a point about 80-300 μ from the surface of the spike axis.





Figs. 1-12: *Pandanus pendulinus.*

Figs. 1-6: Details of staminate spike and stamens; — *1:* staminate spike; — *2:* detail of portion of the surface of the spike, with only the filaments shown; — *3, 4:* stamens; — *5:* stamen with filament in l.s. *(RC* = raphid cells); — *6:* filament in t.s.

Figs. 7-10: T.s. of staminate flower at distances of 45 μ, 90 μ, 120 μ and 255 μ from surface of the spike axis (dark points = each a vascular bundle; sections, 15 μ thick).

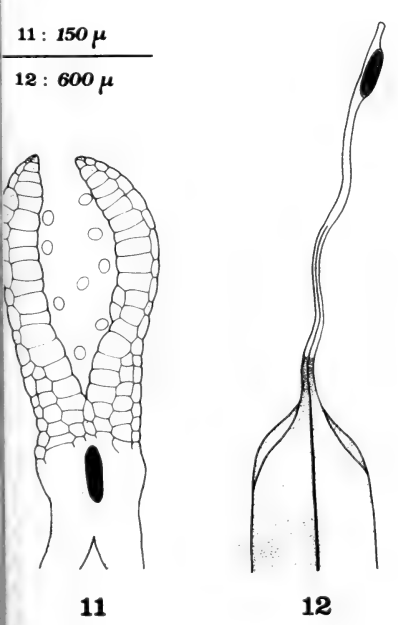


Fig. 11: T.s. of an anther (sections, 15 μ thick; *dotted areas* = endothecially sclerified parts; *large ellipse* = vascular bundle; *smaller ellipses* = pollen grains).

Fig. 12: Apex of anther showing apiculus *(dotted area* = endothecially sclerified part; *middle dark line* = vascular bundle; note raphid cell at apex of apiculus).

Transverse sections of the anthers show them to be elongated and to consist of four walls in two pairs, each pair lying close together and enclosing several pollen grains (Fig. 11, in which only one pair of walls is shown). This structure could be mistaken for a loculus, but in reality, because the loculi open completely in later dehiscence,the locular walls recurve so far that each almost touches the corresponding wall of the other loculus, thus forming a "false" chamber in which pollen grains may be trapped. In the same figure, the pollen grains are shown trapped in the "false" chamber. This can be established by locating the thickest cell-layer of the endothecium in each wall, which is always at the inner side. The outermost cell-layer of the endothecium (i.e. the layer immediately beneath the epidermis) is always the thickest in *Pandanus* (e.g. Plate 5), as has been ascertained in numerous species which have been studied (Huynh, 1982) and in which the epidermis can be identified by the presence of a thick visible cuticle. In the case of *P. pendulinus,* the anther wall cuticle is imperceptible in light microscopy; in fact, even the epidermis is invisible, as it is very thin and closely applied to the endothecium (Plate 6).

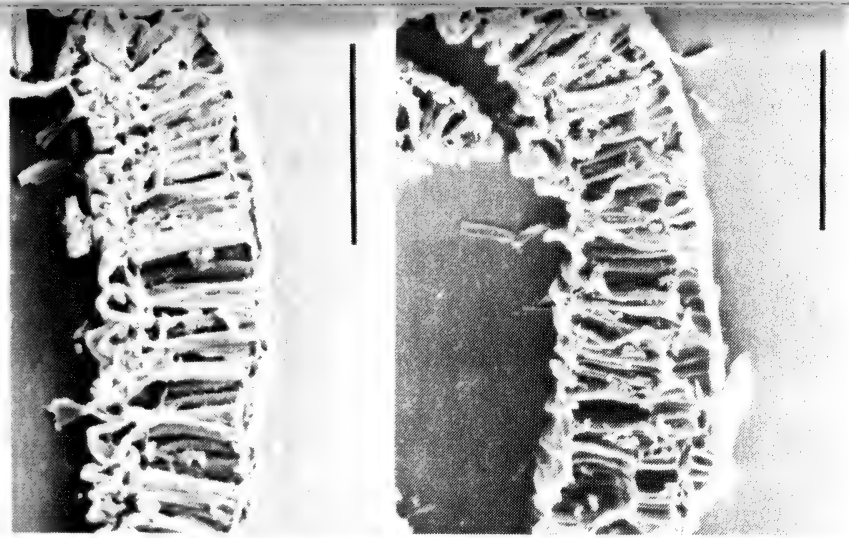
On the taxonomic position of *Pandanus pendulinus*

In a comparative survey of the very variable staminate flowers of *Pandanus,* we have studied most species of which staminate collections have been obtained, these pertaining to 49 different generic sections (Stone, 1974b; Huynh, 1982).

Generally speaking, each natural section has a characteristic staminate flower, and in those sections which are closely related, a similar floral structure has been observed. This general survey provides grounds for a confident decision on the taxonomic position and affinities of *Pandanus pendulinus,* and also permits us to homologize the different parts of the staminate flower of this species with those of other species.

An outstanding feature of the staminate flower of *Pandanus pendulinus* is the arrangement of the 7 to 9 filaments in units of elliptical outline which are attached to the spike axis directly, that is without the usual intervening column (stemonophore). Moreover the filaments are bulbilliform and connate at the base, and each is linked to the anther by a filiform, flexible, translucent basal prolongation of the connective. Staminate flowers of this configuration have until now only been observed in section *Maysops* of subgenus *Lophostigma.*

Another important feature of the staminate flower of *P. pendulinus* is the very long anther apiculus, which may reach a length of 2.5 mm. Apiculi of this length are rather unusual in the genus, although they are known in section *Karuka* (subgenus *Lophostigma)* and in one or two species of section *Rykia* (subgenus *Rykia).* Other characteristics clearly eliminate the possibility of a close relationship of *P. pendulinus* with any species or section outside subgenus *Lophostigma,* however. The staminate flower structure of *P. pendulinus* strongly indicates that its taxonomic position should be in subgenus *Lophostigma,* near to but not within section *Maysops.*



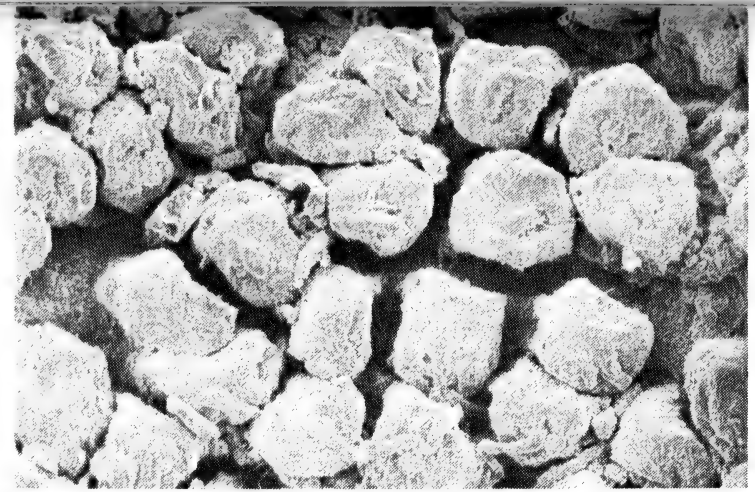


Plate 5 *(top left)* — *Pandanus zea* St John, type-species of section *Maysops* (Cape York, 7. VI. 1948, Brass 19069); transverse section of an anther wall at midlevel (note the epidermis at left, in part with somewhat inflated cells, and the endothecium with two cell-layers and lignin thickenings, and compare with Pl. 6; scale: 50μ).

Plates 6-8, *Pandanus pendulinus:* 6 *(top centre)* — anther wall, transverse section, from the type specimen, scale: 50μ; 7 *(top right)* — apices of filaments and basal prolongations of connectives, x 42; 8 *(bottom left)* — pollen grains, x 1896.

Other facts corroborate this conclusion. The pollen of *P. pendulinus* is provided with a smooth and complete tectum (terminology according to the International Conference on Palynology, Paris, 1975) (Plate 8). Pollen of this type has been observed in the following subgenera: *Acrostigma, Kurzia,* and *Lophostigma.* It occurs most frequently, however, in the sections *Lophostigma, Barrotia, Maysops, Karuka,* and *Asterostigma,* all of subgenus *Lophostigma.*

Characters of other organs also support the assignment of *P. pendulinus* to subgenus *Lophostigma.* For example, the leaves have an obscurely zonate abaxial face, stomates of class VII, and almost uninterrupted chlorenchyma in both adaxial and abaxial faces. Such leaves have been observed also in subgenus *Lophostigma,* e.g. in species of section *Maysops* (Huynh, 1976). Finally there is the biogeographic association: New Guinea is richest in sections of subgenus *Lophostigma* (Stone, 1974b).

Despite the evident affinity of *P. pendulinus* with sections *Maysops* and *Karuka,* it cannot be assigned to either of these. Nor is there any more likely section for it among those belonging to subgenus *Lophostigma.* Of the distinctive characters of *P. pendulinus,* the long filiform translucent anther apiculus is particularly noteworthy. It suggests some isolation of the species. The filiform translucent part between the anther and the bulbilliform process of the stamen provides another peculiarity of the species. That part should be regarded as the basal prolongation of the connective, since it is also filiform and translucent. Therefore the bulbilliform process is the filament, and this is also indicated by its colour (brown, in dry material) and its solitary vascular bundle, characters of filaments of *Pandanus* in general. In *P. pendulinus* this basal prolongation of the connective may be up to 2.5 mm long, which is a most unusual feature. The connective is quite, or almost, devoid of raphid cells, another unusual feature, like the apiculus, which has only a slight amount of endothecial sclerification at the base.

In contrast, in section *Maysops* the basal prolongation of the connective only extends to 0.4 mm (so far as yet known); the connective is rich in raphid cells; the apiculus likewise is rich in raphid cells and moreover is endothecially sclerified from base to apex (Huynh, 1982).

Of the other sections of subgenus *Lophostigma,* those which are endemic to New Caledonia can probably be eliminated as potential allocations for *P. pendulinus,* since it is known only from Papua New Guinea, and also because in those New Caledonian species of the subgenus in which the staminate flowers are known, the floral structure is quite different (the stemonophore terminates in a peltate apex, the stamens have no filaments and are subracemosely attached to the stemonophore: Stone, 1974b; Huynh, 1982). Therefore on biogeographic grounds only the sections *Perrya, Metamaysops, Megastigma, Karuka* and *Liniobtutus* appear to be possible taxonomic sites for *P. pendulinus.* (Section *Paralophostigma,* originally included in subgenus *Lophostigma,* is now assigned to subgenus *Kurzia).* Of the sections mentioned, *Karuka* and *Liniobtutus* can be ruled out. In section *Karuka,* the staminate flower is normally provided with a central staminode (or pistillode; its nature is not quite certain); the filaments are fused from base to apex and lack raphid cells; the connective and apiculus are rich in raphid cells; and the dorsal face

of the distal part of the apiculus is papillate, whereas the ventral face has some epidermal cells with thick lignified walls (Huynh, 1982). Moreover, the leaves have abaxial stomates of Class V (Huynh, 1976). In section *Liniobtutus,* the staminate flower has a stemonophore, the stamens have no basal prolongation of the connective, the anther loculi are not completely opened out by dehiscence, and the pollen is spinulose (Huynh, 1982). Morever, the leaves have abaxial stomates of Class II or III (Huynh, 1976). As to sections *Perrya, Metamaysops,* and *Megastigma,* the staminate plants remain unknown.

Thus it appears that *Pandanus pendulinus* represents a previously unrecognized and still undescribed section of subgenus *Lophostigma.*

Acknowledgements

We expressly thank the directors of the herbaria of the Arnold Arboretum, Harvard University (A) and the Botanical Institute, University of Firenze (FI) for access to the specimens studied, and both the Museum of Comparative Zoology, Harvard University, and the Zoological Institute, University of Neuchâtel, for the use of the scanning electron microscope facilities. The SEM operator in the former institute, Ed Seling, is particularly thanked for his skilful assistance (resulting in our Plates 1-4, 7&8). The Arnold Arboretum is thanked for its support of this project which was carried out while the senior author was on sabbatical leave and based at the Arboretum as a Mercer Fellow.

References

Huynh, K.-L. 1974. La morphologie microscopique de la feuille et la taxonomie du genre *Pandanus*. I. Aperçu général sur les caractères micromorphologiques de la feuille du genre *Pandanus* et leur valeur taxonomique. *Bot. Jahrb. Syst.* 94: 190-256.

———— 1976. La morphologie microscopique de la feuille et la taxonomie du genre *Pandanus*. III. Le sous-genre *Lophostigma*. *Bot. Jahrb. Syst.* 97: 72-119.

———— 1982. La fleur mâle de quelques espèces de *Pandanus* subg. *Lophostigma* (Pandanaceae) et sa signification taxonomique, phylogénique, et évolutive. *Beitr. Biol. Pflanzen* 57 (in press).

Martelli, U. 1929. The Pandanaceae collected for the Arnold Arboretum by L. J. Brass in New Guinea, *J. Arn. Arb.* 10: 137-42.

Stone, B.C. 1974a. Studies in Malesian Pandanaceae XIII. New and noteworthy Pandanaceae from Papuasia. *Contrib. Herb. Austral.* 4: 7-40.

———— 1974b. Towards an improved infrageneric classification in *Pandanus* (Pandanaceae). *Bot. Jahrb. Syst.* 94: 459-540.

Taxonomic and Nomenclatural Notes on *Oxyspora* DC., *Anerincleistus* Korth., *Poikilogyne* Baker f., and *Allomorphia* BL. (Melastomataceae, tribe Oxysporeae)

J.F. MAXWELL
Botanic Gardens
Parks & Recreation Department, Singapore

Abstract

Four genera of Tribe Oxysporeae, Fam. Melastomataceae, have been revised; *Oxyspora* DC., *Anerincleistus* Korth., *Poikilogyne* Baker f., and *Allomorphia* Bl. The concept of *Oxyspora* DC. has been extended so as to include *Allomorphia,* which thus becomes a synonym. This paper consists of three taxonomic sections: *Oxyspora,* as amended; *Anerincleistus;* and *Poikilogyne.* An index to the previously described species of *Allomorphia,* with their revised names, is also provided. There are 5 new species described in *Anerincleistus,* and 7 in *Poikilogyne;* 1 new variety in *Anerincleistus,* 3 in *Oxyspora,* and 1 in *Poikilogyne;* 2 new names in *Oxyspora;* 10 new combinations in *Anerincleistus,* 15 in *Oxyspora;* and three names raised to a new status in *Anerincleistus,* 5 in *Oxyspora,* and 1 in *Poikilogyne.* Three species originally in *Allomorphia* are transferred to *Phyllagathis.*

Contents

Introduction

The genera *Anerincleistus* Korth., *Oxyspora* DC., and *Poikilogyne* Baker f. have been revised, and are accepted as distinct. *Allomorphia* Bl. has also been revised, but is regarded as coming within the taxonomic concept of *Oxyspora*; hence it is reduced to a synonym of that genus. Because of the considerable number of species which had been described under or transferred to *Allomorphia*, a separate index of its taxa, with their revised equivalent names, is here provided. Some species originally attributed to *Allomorphia* belong to genera other than *Oxyspora*, for example *Anerincleistus* and *Phyllagathis.* In *Anerincleistus* and *Poikilogyne,* several new species have been discriminated and are here published. For some of the new taxa, and certain other critical ones, illustrations are provided herein.

Due to the length and detail of the actual revision of *Anerincleistus* (30 spp., 5 var.), *Oxyspora* (24 spp., 9 var.), and *Poikilogyne* (20 spp., 2 var.), along with the numerous notes concerning the species and varieties presented here, I have found it necessary to include only the most essential information concerning each entry here. The specimens cited in the distribution for each taxon have been examined personally, however the herbaria where these can be found have only been listed

Plate 1

Plate 2

Plate 1. *Anerincleistus bullatus* Maxw. *Nooteboom & Chai 1706,* holotype (L). *Photo: Rijksherbarium, Leiden.*

Plate 2. *Pseudodissochaeta roseus* (Guill.) Maxw. *Eberhardt 1769,* from Lang-Bian, Nunh-Thuan Province, Annam, Vietnam; holotype (P). This specimen was originally described by the French botanist A. Guillaumin as *Anerincleistus roseus* Guill. in 1921. This is the sixth known species of *Pseudodissochaeta. Photo: Mr. Wan Ah Kiong.*

Plate 3. *Phyllagathis longifolius* (Cogn.) Maxw. *Beccari 3837* from Sarawak, holotype (FI), which was originally described by Cogniaux in 1891 as *Allomorphia longifolia* Cogn. *Photo: Rijksherbarium, Leiden.*

Plate 3

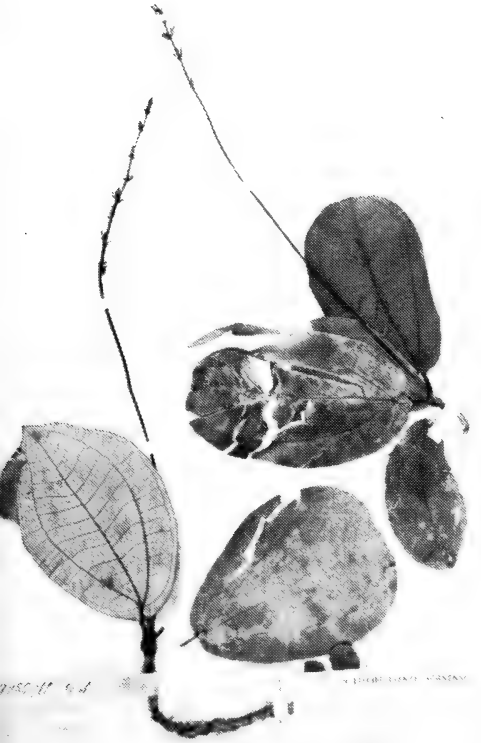


Plate 4

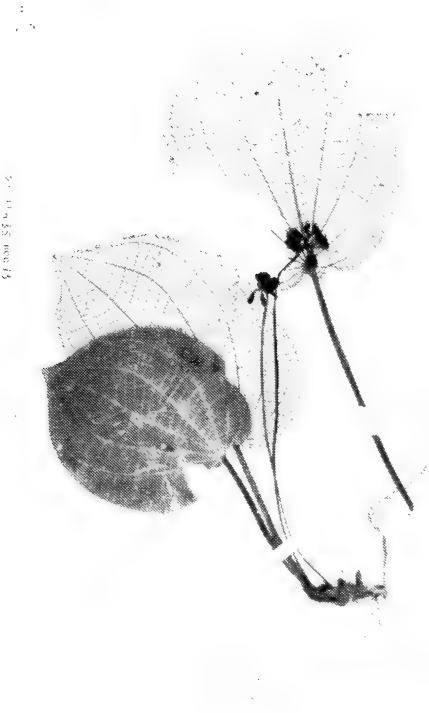


Plate 5

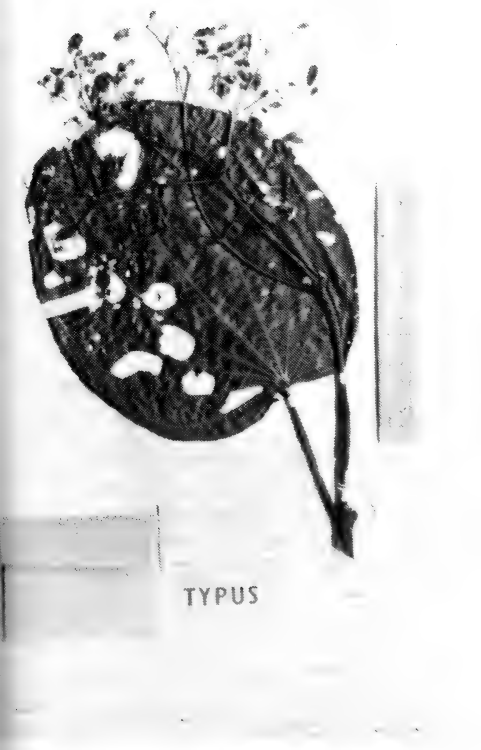


Plate 6

Plate 4. *Phyllagathis longispicatus* (Cogn.) Maxw. *Beccari 3861*, from Sarawak, which was collected in 1867, and described by Cogniaux as *Allomorphia longispicata* Cogn. in 1891; holotype (FI). *Photo: Rijksherbarium, Leiden.*

Plate 5. *Phyllagathis multinervis* (Cogn.) Maxw. *Beccari 3441*, holotype (FI). The original label has "affine *Phyllagathis*", however the specimen was described by Cogniaux as *Allomorphia multinervia* Cogn. in 1891. *Photo: Rijksherbarium, Leiden.*

Plate 6. *Poikilogyne carinata* Maxw., holotype (L). *Photo: Mr. Wan Ah Kiong.*

for types. The completed manuscript, it is hoped, will be published in the near future.

1. Taxonomic Notes on *Anerincleistus* Korth.

NOTE: One species originally attributed to this genus, *A. roseus* Guill., is herein transferred to the genus *Pseudodissochaeta*; see last item in this section.

1. *Anerincleistus angustifolius* (Stapf) Maxw., **comb. nov.**
   Pomatostoma angustifolium Stapf, Icon. Pl. 25 (1895) sub plate 2420.

2. **Anerincleistus bullatus** Maxw., **sp. nov.** (Fig. 1, A-G & Plate 1).

   A partibus pluribus indumento setoso, foliis prominenter bullatis, inflorescentiis umbellatis, lobis calyxis lateraliter complanatis setosisque distincta.

   Typus: Nooteboom & Chai 1706 (holotypus L).

   Distribution — Sarawak: 3rd Division, Hose Mountains, Bukit Kanang Carapa: *Ashton 19064*; Kapit District, Bukit Tibang: *Paie 28449*; 5th Division, Kalabit Highlands, Bario: *J.A.R. Anderson 20145, Nooteboom & Chai 1706* (type).

3. **Anerincleistus cornutus** Maxw., **sp. nov.** (Fig. 2, A-G).

   A calycis lobis longis cornutis lateraliter complanatis distincta.

   Typus: Shah, Samsuri, Shukor, MS 3497 (holotypus SING, isotypi: KEP, KLU)

   Distribution — W. MALAYSIA, Trengganu, Gunong Lawit: *Shah, Samsuri, Shukor MS 3489, 3497* (type), *Ng 022073.*

4. **Anerincleistus cyathocalyx** Maxw., **sp. nov.** (Fig. 3, A-E).

   A speciebus ceteris Anerincleisti distincta quod herba caule setis laevibus ad 4 mm longis. Petioli villosi, nervi pagina inferiore laminis dense setosi. Inflorescentiae umbellato-cymosae plus minusve scorpioideae. Calyx tubo cyathiformi furfuraceo lobis lateraliter complanatis cuspidatis. Stamina equalia inter se.

   Typus: W.M.A. Brooke 10122 (holotypus L).

   Distribution — Sarawak: 5th Division, Maputi: *W.M.A. Brooke 10122* (type).

5. **Anerincleistus echinatus** Maxw., **sp. nov.** (Fig. 4, A-H).

   Ramuli, petioli, costae primariae pagina inferiore foliorum, axes inflorescentiarum tomento appresso strigoso ca. 1 mm crasso obtecti. Inflorescentiae axillares anguste thyrsoideo-racemosae 3.5-7 cm longae, florubus pluribus tantum in alabastro vidi. Calyx campanulatus ca. 3 mm longus, appendicubus echinatus patentibus 2-2.5 mm longis laevibus dense obtectus, lobis linearibus ca. 0.5 mm longis. Capsulae subglobosae echinatae ca. 3 mm diam., apicibus valvarum parum supra marginem aeroli.

   Typus: Endert 3686 (holotypus L, isotypus K).

   Distribution
   Sarawak: 3rd Division, Hose Mountains, Mujong, Ulu Amau, Bukit Lumut: *Ashton 21261.*
   Kalimantan: W. Koetai, near Mt. Kemoel: *Endert 3686* (type).

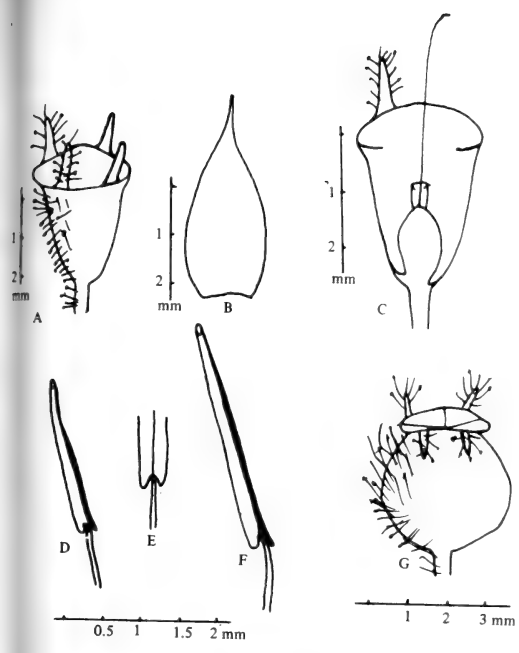


Fig. 1. *Anerincleistus bullatus* Maxw. *A:* calyx showing the gland-tipped hairs, indumentum incomplete; *B:* mature petal, *C:* ovary, *D:* oppositipetalous stamen with thickened connective, *E:* base of anther, *F:* alternipetalous stamen with thickened connective, *G:* capsule with gland-tipped hairs, indumentum incomplete. *A-G: Nooteboom & Chai 1706* (holotype).

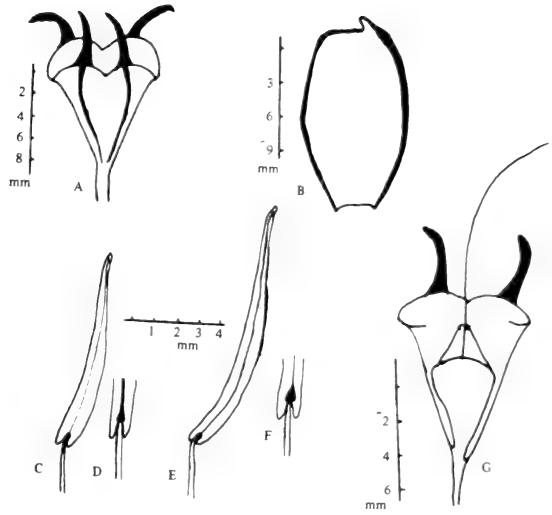


Fig. 2. *Anerincleistus cornutus* Maxw. *A:* calyx with laterally flattened, horn-like calyx lobes and 4-angled calyx tube; *B:* mature petal with thinner margins, *C:* oppositipetalous stamen with thickened connective, *D:* details of the thickened connective, *E:* alternipetalous stamen with thickened connective, *F:* details of the thickened connective, *G:* ovary. *A-G: Shah, Samsuri, Shukor, MS 3497* (holotype).

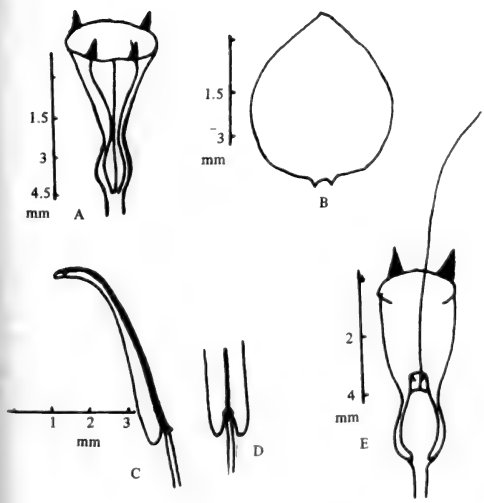


Fig. 3. *Anerincleistus cyathocalyx* Maxw. *A:* calyx with laterally flattened lobes and tube with 8 vertical lines; *B:* mature petal, *C:* mature stamen with thickened connective and spur, *D:* details of the connective and spur, *E:* ovary. *A-E: W.M.A. Brooke 10122* (holotype).

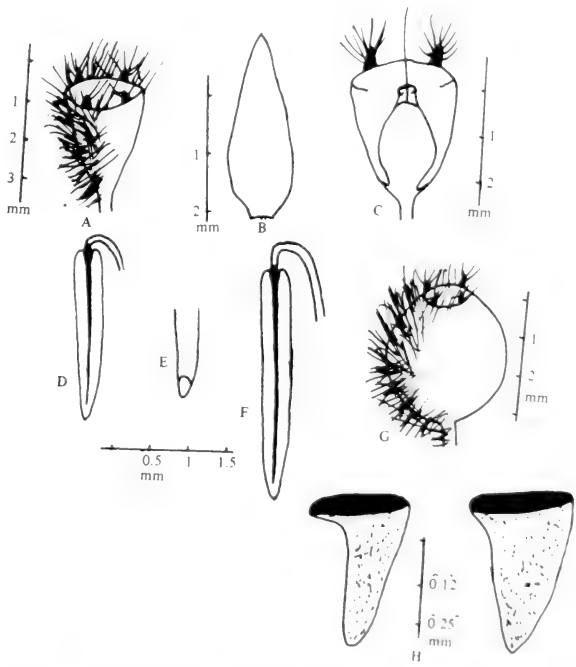


Fig. 4. *Anerincleistus echinatus* Maxw. *A:* calyx with echinate indumentum, incompletely drawn (in bud); *B:* immature petal, *C:* ovary, *D:* oppositipetalous stamen, adaxial (immature); *E:* abaxial tip of anther showing the pore; *F:* alternipetalous stamen, adaxial (immature); *G:* capsule with echinate indumentum (indumentum incomplete), *H:* seeds with flattened, thickened top and papillose testa. *A-G: Hallier 3686* (holotype).

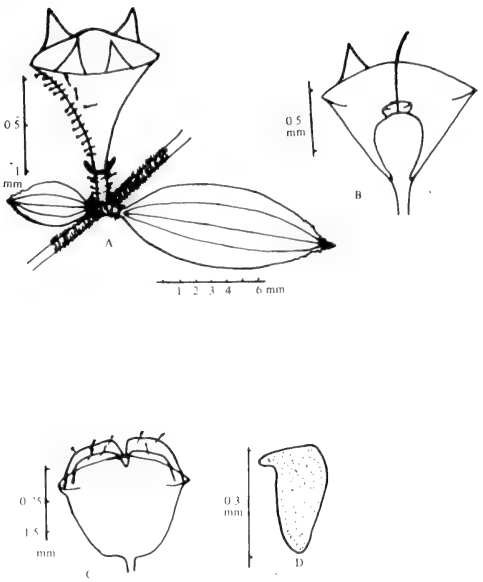


Fig. 5. *Anerincleistus microphyllus* Maxw. *A:* inflorescence (solitary flower) showing the calyx with gland-tipped setae/papillae (incompletely drawn), unequal leaf pairs, and branchlet with glandular indumentum; *B:* ovary, *C:* capsule, long. sect., showing the valves with gland-tipped setae; *D:* seed with papillose testa. *A, B: Lee S. 38060* (holotype), *C, D: Hotta 14499.*

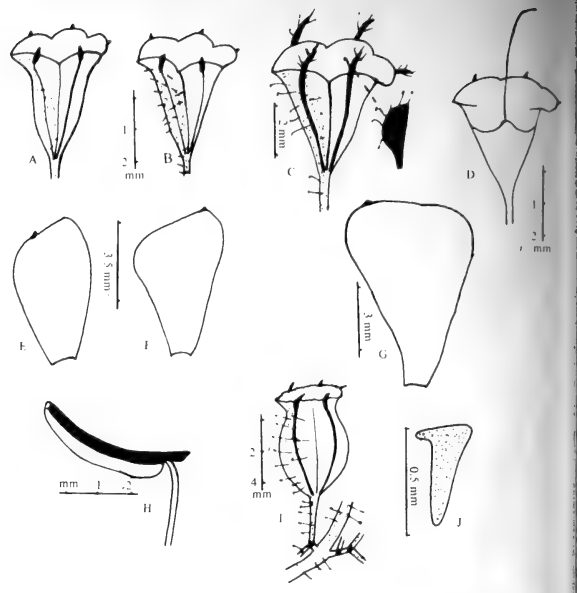


Fig. 7. *Poikilogyne multiflora* Maxw. *A-C:* calyces with furfuraceous indumentum and setae (gland-tipped in *C*), thickened keels on the back of the calyx lobes, insert of *C* is a profile of this keel; and tubes with 10 vertical lines (wing-like in *C*). *D:* ovary and style; *E-G:* mature petals with eccentric cusps, *H:* mature stamen with thickened connective and spur, *I:* mature capsule and part of infructescence showing furfuraceous indumentum and gland-tipped setae, *J:* papillose seed (indumentum incompletely depicted). *A, D, E, H: Streimann & Kairo 47541* (holotype), *B & F: Coode & Lelean 29918; C, G, I, J: Henty & Foreman 42513.*

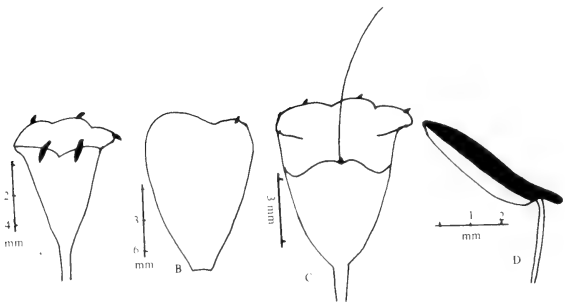


Fig. 6. *Poikilogyne carinata* Maxw. *A:* calyx with a thickened, submarginal keel on the dorsal side of each lobe; *B:* mature petal with an eccentric cusp, *C:* ovary and style, *D:* mature stamen with thickened connective and spur. *A-D: Craven & Shodde 1397* (holotype).

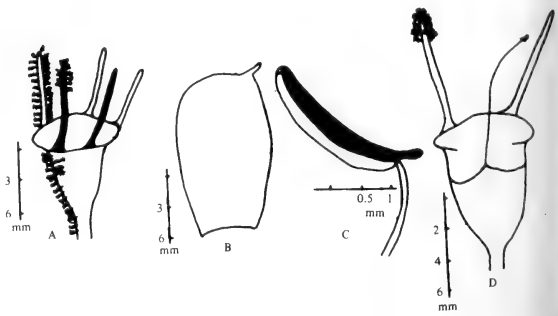


Fig. 8. *Poikilogyne velutina* Maxw. *A:* calyx with a dense indumentum of puberulous hairs and subulate calyx lobes which are glabrous on the inside (indumentum incompletely drawn), *B:* mature petal, *C:* mature stamen with terminal pore and thickened connective and spur, *D:* ovary and style. *A-D: Hartley 12774* (holotype).

6. *Anerincleistus esquirolii* (Lév.) Maxw., **comb. nov.**
   Sonerila esquirolii Lév., Bull. Soc. France 54 (1907) 368.
   Plagiopetalum esquirolii (Lév.) Rehd., J. Arnold Arbor. 15 (1934) 110.

7. *Anerincleistus phyllagathoides* (Stapf) Maxw., **comb. nov.**

   a. var. *phyllagathoides*
   Pomatostoma phyllagathoides Stapf, Icon. Pl. 25 (1895) Plate 2421.

b. var. *inaequalis* (Stapf) Maxw., **comb. & stat. nov.**
Pomatostoma inaequalis Stapf, Icon. Pl. 25 (1895) sub plate 2421.

8. **Anerincleistus microphyllus** Maxw., **sp. nov.** (Fig. 5, A-D).

Species distictissima per folia in partibus inequalissimis inedque minima in Anerincleisto nota, quoum majora 13-15 mm longa, 4.5-5 mm lata; minora ca. 4 mm longa ca. 2.5 mm lata. Partes pleraeque plantae setis papillisve minutis apicibus glandulosis obtectae. Flores axillares solitarii minimi in genere cogniti; calyx tubo infundibuliformi ca. 1 mm longo, lobis triangulatis ca. 0.5 mm longis.

Typus: B. Lee S.38060 (holotypus L; isotypi: K, KEP, MO, SAR).

Distribution: Sarawak: 4th Division, Gunong Mulu: *B. Lee S.38060* (type) *Hotta 14499, Lewis 283, Stone 13637.*

9. *Anerincleistus purpureus* (Stapf) Maxw., **comb. nov.**
Creaghiella purpurea Stapf, Icon. Pl. 25 (1896) plate 2455.

10. *Anerincleistus quintuplinervis* (Cogn.) Maxw., **comb. nov.**
Allomorphia quintuplinervis Cogn. in DC., Monogr. Phan. 7 (1891) 466.

11. *Anerincleistus rupicola* (Nayar) Maxw., **comb. nov.**
Perilimnastes rupicola Nayar, J. Bomb. Nat. Hist. Soc. 71 (1974) 173 and fig. 1.

12. *Anerincleistus sertuliferum* (Cogn.) Maxw., **comb. nov.**
Allomorphia sertuliferum Cogn. in Boerlage, Handl. Fl. Ned. Ind. I:2 (1890) 531 *(nomen)* and in DC., Monogr. Phan. 7 (1891) 465.
Pomatostoma sertuliferum (Cogn.) Stapf, Icon. Pl. 25 (1895) plate 2420.

13. *Anerincleistus setosus* (Nayar) Maxw., **comb. nov.**
Creaghiella setosa Nayar, Gard. Bull. Sing. 26 (1973) 260.

14. *Anerincleistus setulosus* Schwz. var. **floccosus** Maxw., **var. nov.**

A var. setuloso in setis eglandulosis, ramulis et paginis inferioribus laminum triste rubellis in sicco, inflorescentiis ad 2 cm longis 1-3 floribus, calyce setis patentibus 2-3 mm longis dense obtecto itaque facie floccosa, lobis subulatis ca. 0.75 mm longis differt.

Typus: Clemens 27403 (holotypus L, isotypi: B, K (2).

Distribution
Sabah: Mt. Kinabalu, Dallas: *Clemens 26363, 27403* (type);
Tenompok: *Clemens 28493* (aff.).
Sarawak: 3rd Division, Hose Mountain, Bukit Temendu: *Ashton 19016;*
Sadong: *Haviland 3141.*

15. *Anerincleistus setulosus* Schwz. var. *pallidifolius* (Nayar) Maxw., **stat. nov.**
Anerincleistus pallidifolius Nayar, J. Ind. Bot. Soc. 48 (1969) 264 and fig. 1.

16. *Anerincleistus setulosus* Schwz. var. *suffruticosus* (Schwz.) Maxw., **stat. nov.**
Anerincleistus suffruticosus Schwz., Mitt. Inst. Bot. Hamburg 7 (1931) 243.

17. *Anerincleistus stipularis* (Ridl.) Maxw., **comb. nov.**
Phaulanthus stipularis Ridl., J. Str. Br. Roy. As. Soc. 57 (1911) 43.

Excluded Species

Anerincleistus roseus Guill., Bull. Bot. Soc. France. 68 (1921) 4 and Fl. Gen. Indo-Chine II (1921) 906.

= *Pseudodissochaeta roseus* (Guill). Maxw., **comb. nov.** (Dissochaeteae) (Plate 2).

2. Taxonomic Notes on *Oxyspora* DC.

1. *Oxyspora auriculata* (Ridl.) Maxw., **comb. nov.**
   Allomorphia auriculata Ridl., Kew Bull. (1946) 37.
   Campimia auriculata (Ridl.) Nayar, Bull. Bot. Surv. India 14 (1972) 189.

2. *Oxyspora balansaei* (Cogn.) Maxw., **comb. nov.**

   a. var. *balansaei*
      Allomorphia balansaei Cogn. in DC., Monogr. Phan. 7 (1891) 1183.

   b. var. *baviensis* (Guill.) Maxw., **comb. & stat. nov.**
      Allomorphia baviensis Guill., Notulae Syst. 2 (1913) 324.

   c. var. *setosa* (Craib) Maxw., **comb. & stat. nov.**
      Allomorphia setosa Craib, Kew Bull. (1913) 68.

3. *Oxyspora beccarii* (Cogn.) Maxw., **comb. nov.**
   Anerincleistus beccarii Cogn. in DC., Monogr. Phan. 7 (1891) 478.

4. *Oxyspora bullata* (Griff.) Maxw., **comb. nov.**
   Sonerila bullata Griff., Notulae Pl. As. IV (1854) 675.

5. *Oxyspora cordata* (Stapf) Maxw., **comb. nov.**
   Anerincleistus cordata Stapf, Icon. Pl. 4 (1894) plate 2310 and Trans. Linn. Soc. Bot. 2 (1894) 154.

6. *Oxyspora exigua* (Jack) Maxw., **comb. nov.**
   Melastoma exigua Jack, Trans. Linn. Soc. 14 (1825) 10 and tab. 1, fig. 2 (a-f).

7. *Oxyspora longisetosa* (Ridl.) Maxw., **comb. nov.**
   Allomorphia longisetosa Ridl., Kew Bull. (1926) 471.
   Tayloriophyton longisetosum (Ridl.) Nayar, Bull. Bot. Surv. India 10 (1968) 92 and fig. 2.

8. *Oxyspora microflora* Maxw., **nom. nov.**
   Tayloriophyton glabrum Nayar, Bull. Bot. Surv. India 10 (1968) 92 and fig. 1.

   I have reduced *Tayloriophyton* Nayar to a synonym of *Oxyspora*. The specific epithet of *T. glabrum* Nayar cannot be used with *Oxyspora* since the name is occupied by *Oxyspora glabra* Li (J. Arnold Arbor. 25 (1944) 13). The specific epithet *microflora* has been selected since this species has the smallest flowers of all the known species and varieties of *Oxyspora*.

9. *Oxyspora montana* (Diels) Maxw., **comb. nov.**
Cyphotheca montana Diels, Bot. Jahrb. 65 (1932) 103.

10. *Oxyspora paniculata* (D. Don) DC. var. **bracteata** Maxw., **var. nov.**

Varietate vaganti (Roxb.) Maxw. proxima. Ramuli petioli indumento dense stellato-tomentose setis sparsis glabris eglandulosis 1-1.5 mm longis includenti. Laminae chartaceae oblongae ad ovato-oblongae 9-16 cm longae 3.5-5 cm latae, basi angustata ad parum rotundata, apice acuminato infra venatione secondaria non excurrenti setis plurimis obtectae supra setis sparsis. Axes inflorescentiae stellato-furfuracei, esetosi. Bracteae bracteolique prominentes lanceolati 4-7 mm longi 1-1.5 mm lati stellato-furfuracei setis dispersis. Tubus calycis infundibularis c. 6 mm longus, margine truncata cuspis marginalibus dorsaliter carinatis, c. 0.5 mm longis. Calcar antherae alternipetalae ligulatum c. 1 mm longum.

Typus: A.S. Rao 47967 (holotypus CAL).

Distribution — INDIA: Assam, Lohit District, Shillong, Tezn-Denning Road: *A.S. Rao 47967* (type).

11. *Oxyspora paniculata* (D. Don) DC. var. **campanulata** Maxw. **var. nov.**

A var. glandulosa in pedicellis 8-10 mm longis, tubo calycis ca. 2 mm longis lobis triangulatis ca. 0.75 mm longis cuspidatis dorso carinatis, petalis elliptico-oblongis leniter asymmetricis, stylo stellato-piloso differt.

Typus: Keenan, Tun Aung, Hla 3634A (holotypus EDIN, isotypus K).

Distribution — Burma: Kachin State, Sumprabum Subdivision, Sumprabum to Kumon Range, NW. of Hpuginkhu: *Keenan, Tun Aung, Hla 3634A* (type). isotype).

12. *Oxyspora paniculata* (D. Don) DC. var. **glandulosa** W.W. Sm. *ex* Maxw., **var. nov.**

A var. paniculata praecipueque var. vagante ramulis petiolis axibus setis glabris glanduloso-capitatis strictis 1-2 mm longis plerumque dense vestis, tubo calycis idemque sparsioribus, margine cuspidibus 4 lateraliter compressis ca. 0.5 mm longis differt. Var. vagans proxima quae praeterea inflorescentias infrutescentiasque minores gaudet.

Typus: Toppin 4044 (holotypus EDIN).

Distribution — BURMA, Kachin State: Sumprabum Subdivision, Sumprabum to Kumon Pange, Hpuginkhu: *Keenan, Tun Aung, Hla 3682*; west of Tang-Hpre: *Keenan, Tung Aung, Hla 3989*; Kachin Hills: *anon. 5584* (EDIN); S. Shan States, Keng Tung: *MacGregor 1047*; upper Burma: *Toppin 4044* (type).

13. *Oxyspora paniculata* (D. Don) DC. var. *rupicola* (Lace) Maxw., **stat. nov.**
Oxyspora rupicola Lace, Kew Bull. (1915) 402.

14. *Oxyspora paniculata* (D. Don) DC. var. *vagans* (Roxb.) Maxw., **stat. nov.**
Oxyspora vagans (Roxb.) Wall., Pl. As. Rar. I (1830) 78.
Melastoma vagans Roxb., Hort. Bengal. (1814) 33.

15. *Oxyspora paniculata* (D. Don) DC. var. *yunnanensis* (Li) Maxw., **stat. nov.**
Oxyspora yunnanensis Li, J. Arnold Arbor. 25 (1944) 12.

16. *Oxyspora sagittata* (Bakh. f.) Maxw., **comb. nov.**
Allomorphia sagittata Bakh. f., "Thesis" (1943) 291, Med. Mus. Bot. Utrecht 91 (1943) 291, Rec. Trav. Bot. Neerl. 40 (1943-45) 291.

17. *Oxyspora spicata* Maxw., **nom. nov.**
Anerincleistus caudatus Diels, Bot. Jahrb. 65 (1932) 101.
Styrophyton caudatum (Diels) S.Y. Hu, J. Arnold Arbor. 33 (1952) 176 and plate 1.

The specific epithet *caudatus* cannot be used for this species with *Oxyspora* since *Oxyspora caudata* Gedd. (Kew Bull. 1930, 313) has already been described. The specific epithet *spicata* has been chosen to indicate the spicate inflorescence of this species — one of its most obvious traits.

18. *Oxyspora sublepidota* (King) Maxw., **comb. nov.**
Anerincleistus sublepidotus King, J. As. Soc. Bengal 69, II (1900) 17 (Mat. Fl. Mal. Pen. III, 425).

19. *Oxyspora umbellata* (Hk. f. *ex* Triana) Maxw., **comb. nov.**

a. var. *umbellata*
Allomorphia umbellata Hk. f. *ex* Triana, Trans. Linn. Soc. 28 (1871) 74 and Tab. 6, Fig. 66 a.

b. var. *setosa* (Craib) Maxw., **stat. nov.**
Oxyspora setosa Craib, Kew Bull. (1930) 315.

20. *Oxyspora wrayi* (King) Maxw., **comb. nov.**
Allomorphia wrayi King, J. As. Soc. Bengal 69, II (1900) 11 (Mat. Fl. Mal. Pen. III, 419).
Campimia wrayi (King) Ridl., J. Str. Br. Roy. As. Soc. 57 (1911) 40.

3. Index to taxa of *Allomorphia* Bl. with original and revised names

During the course of the revision on *Oxyspora* DC., *Allomorphia* Bl., *Anerincleistus* Korth., *Poikilogyne* Baker f., and related genera, it was found that *Allomorphia* is synonymous with *Oxyspora*, while *Anerincleistus* and *Poikilogyne* are distinct.

Oxyspora was established by A. De Candolle in 1828 on the basis of *Arthrostemma paniculatum* D. Don, from India, which was described in 1823. In 1831 Blume founded *Allomorphia* with *Melastoma exigua* Jack, from Penang, which was originally described in 1825. The two species appear distinct and since Blume's time an additional 57 taxa of *Allomorphia* have been included in this genus. As more species of *Oxyspora* and *Allomorphia* became known, botanists began to find difficulty in distinguishing the two genera. By 1860 three more genera had been described by Naudin (1851) (*Homocentria* Naud. and *Allozygia* Naud.) and Miquel (1860) (*Hylocharis* Miq.) since the species on which these genera were based did not seem to belong to *Oxyspora* or *Allomorphia*. These three genera have since been reduced to synonyms of *Oxyspora*.

King (1900), in his treatment of the Melastomateceae of the Malay Peninsula, attempted to solve the problem by expanding the description of the two genera. He was followed by Ridley (1908 and 1911) who described two more genera (*Oritrephes* Ridl. and *Campimia* Ridl.) which further confused the distinctions between *Oxyspora, Allomorphia,* and *Anerincleistus*.

Oxyspora was envisioned to have large, spreading inflorescences; large flowers; dimorphic anthers with a connective appendage; and large, ellipsoid capsules. *Allomorphia* was considered as having smaller inflorescences and flowers; equal or subequal anthers which are unappendaged; and smaller, urceolate capsules.

King (1900), Ridley (1911 and 1918), Bakhuizen f. (1943, 1943-45), and Nayar (1973 and 1978) were aware of the problems concerning *Oxyspora* and *Allomorphia,* and even considered the possibility of combining the two genera; however all these authors kept the two genera apart. Baillon (1881), in a short note, considered *Allomorphia* as a section of *Oxyspora.* Various botanists concerned with regional treatments of *Oxyspora* and *Allomorphia* have been able to keep the two genera separate, in addition to founding several new genera based on species that did not seem to belong to either genus. This is because the species found in India (Clarke, 1879), Burma (Kurz, 1877), Thailand (Craib, 1931), Indo-China (Guillaumin 1913 and 1921; Diels, 1932), China (Li, 1944), the Malay Peninsula (King, 1900; Ridley, 1922), and the Malay Archipelago (Bakhuizen f., 1943 and 1943-45) are few and easier to delimit. The most recent monographers of the Melastomataceae (Cogniaux, 1891; Krasser, 1893; Gilg, 1897) have also kept the two genera separate. *Oxyspora* and *Allomorphia,* in fact the entire Oxysporeae, have required a thorough revision for many years, thus a very interesting and rewarding project developed in which much convincing evidence was found to confirm the synonomy of *Allomorphia* with *Oxyspora.* Due to the length of the actual revision a preliminary prospectus of *Allomorphia* is presented here.

Allomorphia Bl., Flora 14 (1831) 522 and Bijdr. Nat. Wet. 6 (1831) 262 = *Oxyspora* DC. sect. *Allomorphia* (Bl.) Baill., Nat. Hist. Pl. 7 (1881) 13. Type: *Allomorphia exigua* (Jack) Bl.

Basionym: *Melastoma exigua* Jack, Trans. Linn. Soc. 14 (1825) 10 and tab. 1, fig. 2 (a-f).

NOTE: Taxa printed in bold are the accepted ones, those in italics have been reduced, and those in roman are new synonyms.

1. *Allorphia acutangula* (King) Guill., Bull. Soc. Bot. France 60 (1913) 87 = **Oxyspora acutangula** King, J. As. Soc. Bengal 69, II (1900) 9 (Mat. Fl. Mal. Pen. III, 417).
2. Allomorphia alata Scort. *ex* King, J. As. Soc. Bengal 69, II (1900) 12 (Mat. Fl. Mal. Pen. III, 417) = **Oxyspora curtisii** King, J. As. Soc. Bengal 69, II (1900) 9 (Mat. Fl. Mal. Pen. III, 417).
3. Allomorphia albiflora Ridl., J. Fed. Mal. St. Mus. 4 (1909) 15: *Oritrephes albiflora* (Ridl.) Ridl., Fl. Mal. Pen. II (1922) 772; = **Oxyspora acutangula** King, J. As. Soc. Bengal 69, II (1900) 9 (Mat. Fl. Mal. Pen. III, 417).
4. Allomorphia arborescens Guill., Notulae Syst. II (1913) 323 = **Oxyspora balansaei** (Cogn.) Maxw. var. **setosa** (Craib) Maxw.
5. *Allomorphia asperifolia* Mansf., Nova Guinea 14 (1924) 201 = **Poikilogyne arfakensis** Baker f. (var. **arfakensis**) in Gibbs, Contr. Fl. Arfak Mtns. (1917) 157; Mansfeld, Bot. Jahrb. 60 (1926) 110, *pro syn.*

6. *Allomorphia auriculata* Ridl., Kew Bull. (1946) 37 = **Oxyspora auriculata** (Ridl.) Maxw.

7. *Allomorphia balansaei* Cogn. in DC., Monogr. Phan. 7 (1891) 1183 = **Oxyspora balansaei** (Cogn.) Maxw. var. **balansaei.**

8. *Allomorphia baviensis* Guill., Notulae Syst. II (1913) 324 and Bull. Soc. Bot. France 60 (1913) 89 (in key) = **Oxyspora balansaei** (Cogn.) Maxw. var. **baviensis** (Guill.) Maxw.

9. *Allomorphia beccariana* Cogn. in Boerl., Handl. Fl. Ned. Ind. I:2 (1890) 531 *(nomen)* and in DC., Monogr. Phan. 7 (1891) 467 = **Phyllagathis beccariana** (Cogn.) Nayar, J. Jap. Bot. 51 (1976) 231.

10. *Allomorphia blinii* (Lév.) Guill., Bull. Bot. Soc. France 60 (1913) 87 = **Anerincleistus esquirolii** (Lév.) Maxw.

11. *Allomorphia bodinieri* (Lév.) Lév., in Fedde, Repert. Nov. Sp. 5 (1908) 100 = **Blastus cavaleriei** Lév., Mem. Soc. Sci. Nat. Cherbourg 35 (1906) 395; Li, J. Arn. Arbor. 25 (1944) 17, *pro syn.*

12. *Allomorphia bullata* (Griff.) Cogn. in DC., Monogr. Phan. 7 (1891) 465 = **Oxyspora bullata** (Griff.) Maxw.

13. Allomorphia capillaris Cogn. *ex* Ridl., J. Str. Br. Roy. As. Soc. 57 (1911) 38 = **Oxyspora exigua** (Jack) Maxw.

14. *Allomorphia caudata* (Diels) Li, J. Arn. Arbor. 25 (1944) 11.
Styrophyton caudatum (Diels) S.Y. Hu, J. Arn. Arbor. 33 (1952) 176 and plate I: = **Oxyspora spicata** Maxw., *nom. nov.* The specific epithet of this species cannot be transferred to *Oxyspora* since the name is occupied by *Oxyspora caudata* Gedd.

15. *Allomorphia cavaleriei* Lév. & Van., Mem. Soc. Sci. Nat. Cherbourg 35 (1906) 394 = **Phyllagathis cavaleriei** (Lév. & Van.) Guill., Bull. Soc. Bot. France 60 (1913) 273.

16. *Allomorphia chevalierii* Guill., Fl. Gen. Indo-China II (1921) 901, *nomen* (in key); probably in reference to *Allormorphia cavaleriei* Lév. & Van. (q.v.).

17. *Allomorphia cordifolia* Cogn. in K. Sch. & Hollr., Fl. Kais.-Wilhelmsl. (1889) 87 = **Poikilogyne cordifolia** (Cogn.) Mansf., Bot. Jahrb. 60 (1926) 111 (var. **cordifolia**).

18. *Allomorphia curtisii* (King) Ridl., J. Str. Br. Roy. As. Soc. 57 (1911) 40 = **Oxyspora curtisii** King, J. As. Soc. Bengal 69, II (1900) 9 (Mat. Fl. Mal. Pen. III, 417).

19. *Allomorphia curtisii* (King) Guill., Bull. Soc. Bot. France 60 (1913) 87 = **Oxyspora curtisii** King, J. As. Soc. Bengal 69, II (1900) 9 (Mat. Fl. Mal. Pen. III, 417).

20. Allomorphia eupteron Guill., Notulae Syst. II (1913) 323 = **Oxyspora curtisii** King, J. As. Soc. Bengal 69, II (1900) 9 (Mat. Fl. Mal. Pen. III, 417).

21. *Allomorphia exigua* (Jack) Bl., Flora 14 (1831) 523 and Bijdr. Nat. Wet. 6 (1831) 262 = **Oxyspora exigua** (Jack) Maxw.

22. *Allomorphia exigua* (Jack) Bl. var. *capillaris* (Cogn. *ex* Ridl.) Ridl., Fl. Mal. Pen. I (1922) 770 = **Oxyspora exigua** (Jack) Maxw.

23. Allomorphia exigua (Jack) Bl. var. *minor* King, J. As. Soc. Bengal 69, II (1900) 11 (Mat. Fl. Mal. Pen. III, 419) = **Oxyspora exigua** (Jack) Maxw.

24. Allomorphia flexuosa Hand.-Maz., Sinensia III (1933) 195 = **Anerincleistus esquirolii** (Lév.) Maxw.

25. *Allomorphia griffithii* Hk. f. *ex* Triana, Trans. Linn. Soc. 28 (1871) 74 = **Phyllagathis griffithii** King, J. As. Soc. Bengal 69, II (1900) 45 (Mat. Fl. Mal. Pen. III, 453).

26. Allomorphia hirticalyx Ridl., J. Fed. Mal. St. Mus. 6 (1915) 46 = **Oxyspora acutangula** King, J. As. Soc. Bengal 69, II (1900) 9 (Mat. Fl. Mal. Pen. III, 417).

27. *Allomorphia hispida* Kurz, J. As. Soc. Bengal 40, II (1871) 53; Ridley, J. Str. Br. Roy. As. Soc. 79 (1918) 69, excluded from *Allomorphia.*

28. Allomorphia howelii (Jeff. & W.W. Sm.) Diels, Bot. Jahrb. 65 (1932) 102 = **Oxyspora balansaei** (Cogn.) Maxw. var. **setosa** (Craib) Maxw.

29. Allomorphia laotica Guill., Notulae Syst. II (1913) 324 = **Oxyspora curtisii** King, J. As. Soc. Bengal 69, II (1900) 9 (Mat. Fl. Mal. Pen. III, 417).

30. *Allomorphia longifolia* Cogn. in Boerl., Handl. Fl. Ned. Ind. I:2 (1890) 531 (*nomen*) and in DC., Monogr. Phan. 7 (1891) 466 = **Phyllagathis longifolius** (Cogn.) Maxw., **comb. nov.** (Plate 3).

31. *Allormorphia longisetosa* Ridl., Kew Bull. (1926) 471; *Tayloriophyton longisetosum* (Ridl.) Nayar, Bull. Bot. Surv. India 10 (1968) 92 and fig. 2 = **Oxyspora longisetosa** (Ridl.) Maxw.

32. *Allomorphia longispicata* Cogn. in Boerl., Handl. Fl. Ned. Ind. I:2 (1890) 531 (*nomen*) and in DC., Monogr. Phan. 7 (1891) 46 = **Phyllagathis longispicatus** (Cogn.) Maxw., **comb. nov.** (Plate 4).

33. *Allomorphia macrophylla* Cogn. in K. Sch. & Hollr., Fl. Kais.-Wilhelmsl. (1889) 87 = **Poikilogyne macrophylla** (Cogn.) Mansf., Bot. Jahrb. 60 (1926) 111.

34. Allomorphia magnifica (Miq.) Guill., Bull. Soc. Bot. France 60 (1913) 88 = **Oxyspora bullata** (Griff.) Maxw.

35. Allomorphia malaccensis Ridl., J. Str. Br. Roy. As. Soc. 79 (1918) 69 = **Oxyspora bullata** (Griff.) Maxw.

36. *Allomorphia multiflora* Cogn. in DC., Monogr. Phan. 7 (1891) 1183 = **Blastus multiflorus** (Cogn.) Guill., Bull. Soc. Bot. France 60 (1913) 90.

37. *Allormorphia multinervia* Cogn. in Boerl., Handl. Fl. Ned. Ind. I:2 (1890) 531 (*nomen*) and in DC., Monogr. Phan. 7 (1891) 468 = **Phyllagathis multinervis** (Cogn.) Maxw., **comb. nov.** (Plate 5).

38. *Allomorphia ovalifolia* (A. Gray) Triana, Trans. Linn. Soc. 28 (1871) 74 = **Medinilla ovalifolia** (A. Gray) A.C. Smith, Contr. U.S. Nat. Herb. 37 (1976) 85.

39. *Allomorphia parvifolia* Mansf., Nova Guinea 14 (1924) 201.
Dicerospermum parviflorum (Mansf.) Bakh. f., "Thesis" (1943) 280, Med. Mus. Bot. Utrecht 91 (1943) 280, Rec. Trav. Bot. Neerl. 40 (1943-45) 280 = **Poikilogyne parviflora** (Mansf.) Mansf., Bot. Jahrb. 60 (1926) 110.

40. *Allomorphia pauciflora* Benth., Lond. J. Bot. 1 (1842) 485 = **Blastus pauciflorus** (Benth.) Guill., Bull. Soc. Bot. France 60 (1913) 90.

41. Allomorphia perakensis Nayar, Bull. Bot. Surv. India 15 (1973) 170 = **Oxyspora curtisii** King, J. As. Soc. Bengal 69, II (1900) 9 (Mat. Fl. Mal. Pen. III, 417).

42. Allomorphia porphyranthera Ridl., J. St. Br. Roy. As. Soc. 57 (1911) 39 = **Oxyspora exigua** (Jack) Maxw.

43. Allomorphia procursa Craib, Kew Bull. (1930) 315 = **Oxyspora curtisii** King, J. As. Soc. Bengal 69, II (1900) 9 (Mat. Fl. Mal. Pen. III, 417).

44. *Allomorphia quintuplinervia* Cogn. in Boerl., Handl. Fl. Ned. Ind. I:2 (1890) 531 (*nomen*) and in DC., Monogr. Phan. 7 (1891) 466 = **Anerincleistus quintuplinervis** (Cogn.) Maxw.

45. *Allomorphia racemosa* (Ridl.) Bakh. f., "Thesis" (1943) 289, Med. Mus. Bot. Utrecht 91 (1943) 289, Rec. Trav. Bot. Neerl. 40 (1943-45) 289 = **Oxyspora racemosa** Ridl., J. Mal. Br. Roy. As. Soc. 1 (1923) 60.

46. *Allomorphia robusta* Mansf., Nova Guinea 14 (1924) 201 = **Poikilogyne robusta** (Mansf.) Mansf., Bot. Jahrb. 60 (1926) 111.

47. *Allomorphia roemeri* Mansf., Nova Guinea 14 (1924) 201 = **Poikilogyne roemeri** (Mansf.) Mansf., Bot. Jahrb. 60 (1926) 110.

48. *Allomorphia rosea* Ridl., Trans. Linn. Soc. II (1893) 301 = **Oxyspora rosea** (Ridl.) Ridl., J. Str. Br. Roy. As. Soc. 57 (1911) 35.

49. Allomorphia rosea Ridl., J. Fed. Mal. St. Mus. 4 (1909) 14 = **Oxyspora sublepidota** (King) Maxw.

50. *Allomorphia sagittata* Bakh. f., "Thesis" (1943) 291, Med. Mus. Bot. Utrecht 91 (1943) 291, Rec. Trav. Bot. Neerl. 40 (1943-45) 291 = **Oxyspora sagittata** (Bakh. f.) Maxw.

51. *Allomorphia sertulifera* Cogn. in Boerl., Handl. Fl. Ned. Ind. I:2 (1890) 531 *(nomen)* and in DC., Monogr. Phan. 7 (1891) 465.
Pomatostoma sertuliferum (Cogn.) Stapf, Icon. Pl. 25 (1895) plate 2420 = **Anerincleistus sertuliferum** (Cogn.) Maxw.

52. *Allomorphia setosa* Craib, Kew Bull. (1913) 68 = **Oxyspora balansaei** (Cogn.) Maxw. var. **setosa** (Craib) Maxw.

53. *Allomorphia subsessilis* Craib, Kew Bull. (1913) 69 = **Pseudodissochaeta subsessilis** (Craib) Nayar, J. Bomb. Nat. Hist. Soc. 65 (1965) 561 and fig. 2.

54. Allomorphia sumatrana Boerl. & Koord. in Koord.-Schum., Syst. Verz. (1911) 46 = **Oxyspora exigua** (Jack) Maxw.

55. Allomorphia sylvarum Gedd., Kew Bull. (1930) 316 = **Oxyspora balansaei** (Cogn.) Maxw. var. **balansaei.**

56. *Allomorphia umbellata* Hk. f. *ex* Triana, Trans. Linn. Soc. 28 (1871) 74 = **Oxyspora umbellata** (Hk. f. *ex* Triana) Maxw. var. **umbellata.**

57. Allomorphia urophylla Diels, Bot. Jahrb. 65 (1932) 102 = **Oxyspora balansaei** (Cogn.) Maxw. var. **balansaei.**

58. *Allomorphia wrayi* King, J. As. Soc. Bengal 69, II (1900) 11 (Mat. Fl. Mal. Pen. III, 419).
Campimia wrayi (King) Ridl., J. Str. Br. Roy. As. Soc. 57 (1911) 40 = **Oxyspora wrayi** (King) Maxw.

4. Taxonomic Notes on *Poikilogyne* Baker f.

1. *Poikilogyne arfakensis* Baker f. var. **glabra** Kosterm. *ex* Maxw., **var. nov.**

A var. arfakensi differt, quoniam glaberrima vel ramulis axibusve minute brevissime furfuraceo-puberulis.

Typus: Kostermans 2299 (holotypus L, isotypes BO,K).

Distribution — NEW GUINEA, IRIAN JAYA, Vogelkop Peninsula, Manokwari Subdistrict, Arfak Mountains, Angi Gita Lake: *Kostermans 2299* (type), *Sleumer & Vink 14064.*

2. **Poikilogyne bicolor** Maxw., **sp. nov.**

Frutex epiphyticus c. 1 m altus. Ramuli petioli axes inflorescentiae tereti furfuracei setis patentibus glabris c. 2 mm longis dense obtecti. Laminae late ovate 10.5-23 cm longae 5-15 cm latae tenues superne sparse setaceae infra in costis dense setaceae. Inflorescentiae terminales paniculatae compacte. Flores 5-meri. Tubus calycis campanulatis c. 4 mm longus sparse furfuraceus ad glaber aliquot setis patentibus, lobis late rotundatis c. 1 mm longis dorsaliter cristatis cuspidatis. Filamenta pilis minutis glandulosis. Petalis alba vel pallidae caeruleus.

Typus: van Royen & Sleumer 7777 (holotypus L).

Distribution — IRIAN JAYA, Vogelkop Peninsula, Ije River Valley, Central Tamarau Range, south slope, path from Sudjak to Mt. Kusemun near Aiwa River; 850 m: *van Royen & Sleumer 7777* (type).

3. **Poikilogyne carinata** Maxw., **sp. nov.** (Fig. 6, A-D & Plate 6).

Ramuli petiole axes inflorescentiae quadrangulati sparse furfuracei glabrescentique lenticellis pusticulatis asperi. Laminae suborbiculares c. 23 cm longae c. 19.5 cm latae subcoriaceae, basi cordata. Inflorescentiae terminales paniculatae pluriflorae c. 30 cm longae. Flores 5-meri. Tubus calycis glaber laevis c. 6 mm longus, lobis late rotundatis c. 1 mm longis, crista dorsali submarginali c. 1.5 mm longa incrassata.

Typus: Craven & Schodde 1397 (holotypus L, isotypi CANB, LAE).

Distribution — PAPUA NEW GUINEA: Morobe District, Aseki Patrol Area, near Kwaimengu: *Craven & Schodde 1397* (type).

4. *Poikilogyne cordifolia* (Cogn.) Mansf. var. *ledermannii* (Mansf.) Maxw., **stat. nov.**
Poikilogyne ledermannii Mansf., Bot. Jahrb. 60 (1926) 111.

5. **Poikilogyne diastematica** Maxw., **sp. nov.**

Per ramulos acute 4-angulatis ad 4-alatos laeves glabros, flores 4-meros, stamina diastemate inter basim loculorum antherae filamentumque distincta.

Typus: Carr 15101 (holotypus SING, isotypi: SING, L, AAU, K)
Distribution — PAPUA NEW GUINEA, Central Division: *Owen Stanley Range*, NW. of the Gap: *Carr 15101* (type).

6. **Poikilogyne grandiflora** Maxw., **sp. nov.**

Omnino laevis et quasi glabra, laminibus suborbicularibus, floribus fructibusque maximis in genere cognita distincta. Tubus calycis infundibuliformis ca. 8 mm longis undis marginalibus 5 ca. 0.5 mm altis coriacues. Petala perinde incrassata asymmetrice obovata in alabastro ca. 14 mm longa 7 mm lata. Capsulae subgloboso-urceolatae incrassatae prominenter cristata 11-12 mm longae 8-9 mm diam. in sicco apicibus conicis 5-porcatis margini areoli complanis.

Typus: Brass 22835 (holotypus L, isotypus A).

Distribution — PAPUA NEW GUINEA, Milne Bay District: Maneau Range, north slope of Mt. Dayman, 2100 m: *Brass 22835* (type), Mt. Suckling: *Stevens & Veldkamp 54118.*

7. **Poikilogyne multiflora** Maxw., **sp. nov.** (Fig. 7, A-J).

Ramuli inflorescentiae infrutescenciaeque dense furfuracei cum vel sine setis glabris 1-2 mm longis. Laminae suborbiculares 15-24 cm longae 12-19.5 cm latae tenues plerumque superne glabrae, infra minute scabrae, apice acuto, basi cordata. Inflorescentiae terminales paniculatae pluriflorae ad c. 30 cm longae. Flores 5-meri. Tubus calycis 3-4 mm longus sparse furfuraceus saepe setis dispersis, lobis late rotundatis c. 0.5 mm longis cuspidatis dorso carinatus vel crista lateraliter complanata. Capsulae 6-7 mm longae prominenter 10-porcatae. Semina cuneata papillata c. 0.5 mm longa.

Typus: Streimann & Kairo 47541 (holotypus L, isotypi LAE, BRI, CANB, A, K, BO, SING, SYD).

Distribution — PAPUA NEW GUINEA: West Sepik District, Telefomin Subdistrict, Prospect Creek near Frieda River: *Henty & Foreman 42513*; Prospect & Kokoma Creeks: *Henty & Foreman 42677*; Eastern Highlands District, Okapa to Wanitabi: *Coode & Lelean 29918*; Morobe District, Wau Subdistrict — Kulai Creek, 5 miles south of Wau: *Hartley 11489*; Mt. Kaindi: *Whiffin et al. 60317*; New Uamap, head of Bamie Creek: *Streimann & Kairo 47541* (type); Milne Bay District, Normanby Island, Mt. Solomonai: *Croft et al. 68934.*

8. **Poikilogyne velutina** Maxw., **sp. nov.** (Fig. 8, A-D).

A indumento pilorum puberulorum ad 0.75 mm longorum dense velutino in ramulis foliis inflorescentiisque lobis calycis subulatis, ca. 7 mm longis distincta.

Typus: Hartley 12774 (holotypus L)

Distribution — PAPUA NEW GUINEA, Morobe District: above Bakaia, moss forest, c. 2700 m: *Hartley 12774* (type).

9. **Poikilogyne villosa** Maxw., **sp. nov.**

Ramuli, folia, axes inflorescentiarum et infructescentiarumque, calyces, capsulaeque villosi pilis mollibus glandulosis eglandulosisque. Inflorescentiae axillares terminalesque. Flores 4-meri. Lobi calycus prominentes 1-4 mm longi.

Typus: Gillison 25350 (holotypus L; isotypi: BRI, CANB, AK, K).

Distribution —— PAPUA NEW GUINEA, Milne Bay District: Mt. Ne near Ulanga Bay: *Gillison 25350* (type), Rossel Island, Kwa Mountain: *Henty 27067,* Sudest Island, Mt. Riu (west slope): *Brass 27883, 27923.*

Acknowledgements

I would like to thank Drs. R. Geesink and Dr. J.F. Veldkamp of the Rijksherbarium, Leiden for their valuable assistance in arranging for numerous specimens that were made available to me on loan and for various important technical matters, and Dr. J.F. Veldkamp for the Latin diagnoses and for various comments on my original descriptions. Thanks are due to Dr. B.C. Stone of the University of Malaya for his valuable comments on my manuscript and drawings. My visit to Leiden was made possible with the financial assistance of Prof. Dr. C.G.G.J. van Steenis, Director of the Flora Malesiana Foundation and Prof. Dr. C. Kalkman, Director of the Rijksherbarium, Leiden. I am also indebted to Dr. Kåre Bremer (Swedish Museum of Natural History, Stockholm) who located several valuable specimens in Paris for me which were subsequently sent to Singapore. Finally, I must express my sincere thanks to the curators and staff of all the herbaria who sent me specimens to study or welcomed me during my visits: A, AAU, ABD, B, BK, BKF, BM, BO, BR, BRI, CAL, EDIN, FI, G, HBG, K, KEP, KLU, L, LWG, MO, National University of Singapore, NY, P, SAN, SAR, U, UC, US, W and Z (abbreviations from Holmgren & Kruken, 1974).

References Cited

Baillon, H. (1881). *Natural History of Plants* 7, 13. Reeve, London.

Bakhuizen van den Brink, R.C. Jr. (1943, 1943-45). A Contribution to the Knowledge of the Melastomataceae Occurring in the Malay Archipelago, Especially in the Netherlands East Indies. "Thesis" 32, 288-292; *Med. Mus. Bot. Utrecht* 91: 32, 288-292; *Rec. Trav. Bot. Neerl.* 40: 32, 288-292.

Blume, C.L. (1831). *Flora* 14, 522 and *Bijdr. Nat. Wet.* 6, 262.

De Candolle, A. (1828). *Prodromus Systematis Naturalis Regni Vegetabilis* III, 123 and *Mémoires sur la Famille des Melastomacées,* 33, Treuttel & Wurz, Paris.

Clarke, C.B. (1879) in J.D. Hooker, *Flora of British India* II, 525-527. Reeve, London.

Cogniaux, A. (1891) in de Candolle, *Monographie Phanerogamarum* 7, 463-472, 477-479.

Craib, W.G. (1931). *Florae Siamensis Enumeratio* I:4, 684-687.

Diels, L. (1932). Ubersicht der Gattungen und Arten der Oxysporeae und Sonerilleae Ostasiens. *Bot. Jahrb.* 65, 99-104.

Gilg, E. (1897) in Engler & Prantl, Melastomataceae. *Die Natürliche Pflanzenfamilien* 3:7, Supplement; 263-268.

Guillaumin, A. (1913). Contribution à l'Étude des Mélastomacées d'Extrême-Orient: II, Oxysporées. *Bull. Bot. Soc. France* 60, 86-89.

————. (1921) Melastomacees. in Lecomte & Gangepain, *Flore Génerale de l'Indo-Chine* II, 900-907.

Holmgren, P.K. and W. Keuken (1974) *Index Herbariorum* I, ed. 6; 303-354. Oosthoek, Tcheltema & Holkema, Utrecht.

King, G. (1900). Materials for a Flora of the Malay Peninsula, Melastomaceae. *J. As. Soc. Bengal* 69, II:1; 2, 8-12 (410, 416-420).

Krasser, F. (1893). in Engler & Prantl, Melastomataceae. *Die Natürliche Pflanzenfamilien* 3:7, 168-170.

Kurz, S. (1877). *Forest Flora of British Burma* I, 505-506. Calcutta.

Li, H.L. (1944). Studies in the Melastomataceae of China, *J. Arn. Arbor.* 25; 2, 9-13.

Miquel, F. (1860). *Flora Nederlandsch Indië,* Supplement I, Sumatra; 319.

Naudin, C. (1851). Melastomacearum. *Ann. Sci. Nat.* 3:15, 308-310.

Nayar, M.P. (1973). A Note on the Genus *Allomorphia* Bl. (Melastomataceae) and a New Species from Malaya. *Bull. Bot. Surv. India* 15, 169-171.

————. (1978). Notes on Asiatic Melastomataceae (2), the Genus *Hylocharis* Miq. and the New Combinations. *J. Jap. Bot.* 53:11, 332-335.

Ridley, H. N. (1908). Plants from Gunong Tahan, Pahang. *J. Linn. Soc.* 38, 309.

————. (1911). A Scientific Expedition to Temengoh. *J. Str. Br. Roy. As. Soc.* 57, 40-48.

————. (1918). New and Rare Malayan Plants. *J. Str. Br. Roy. As. Soc.* 79, 70.

————. (1922). *Flora of the Malay Peninsula* I; 761, 766-778. Reeve, London.

IN MEMORIAM

Encik Kiah bin Haji Mohamed Salleh (1902-1982)

It is with regret that I heard of the death of Encik Kiah bin Haji Mohamed Salleh on 12 September 1982 in Singapore. Kiah was appointed as a plant collector in the herbarium, Botanic Gardens, Singapore in 1920 and retired at the end of 1957 after over 37½ years of dedicated service. He was already on the staff when I first went to Singapore in July 1922 and my first close acquaintance with him was in November of that year when Mr. I. H. Burkill arranged for me to do some collecting in Johore and Negri Sembilan accompanied by Mohamed Nur and Kiah. At Mr. Burkill's request, I paid special attention to ferns, of which I had already acquired some knowledge; Kiah and I learned much about other plants from Mohamed Nur. Afterwards Kiah went with me to many other places, including Mt. Kinabalu, to which I will refer later.

Kiah accompanied the senior members of the Gardens staff on most of the collecting journeys in the Malay Peninsula during his time and I regret that I have not a complete list of them. The value of the herbarium specimens preserved in Singapore and distributed as duplicates during many years is largely due to his care and skill in handling and drying them in the field; on that material much of our current knowledge of Malayan plants depends.

In addition to the journeys arranged by the Gardens, Kiah accompanied expeditions organized from other institutions on several occasions. In 1924 he went with Boden Kloss, then Director of the Raffles Museum, Singapore, to the Mentawai Islands, and again with F. W. Forworthy, Forest Research Officer, to peninsular Thailand in 1930, also helping two other forest botanists on other occasions: E. J. Strugnell in Pahang in 1930 and C. F. Symington on Gunong Tapis in 1937. He was responsible for the collecting on an expedition to Gunong Padang in Trengganu organised by L. Moysey in 1937. The principal collecting journey undertaken independently by Kiah was to Kedah and Perlis in March and April 1938, including Gunong Liang, the Koh Moi Forest Reserve, and the limestone hill at Baling. There can have been few people who travelled more widely in Malayan forests than Kiah.

Between collecting expeditions, Kiah helped in the routine work of the herbarium, undertaking the poisoning of all specimens and preparing them for mounting or despatch to other herbaria. As his knowledge grew, he helped Mohamed Nur in sorting specimens for identification.

In 1931 Kiah went with me to Mt. Kinabalu. There was no road in those days. We landed our baggage at Usukan Bay near Kota Belud, where the District Officer was very helpful in recruiting a team of carriers with whom we walked to Dallas, where we joined Joseph and Mary Clemens who were spending a prolonged period for collecting on the mountain. They had a base at Tenompok, from which we climbed the the top of the mountain, later visiting Kiau and then climbing the Marei Parei Ridge. I concentrated my attention on ferns, which had been my

Kiah bin Haji Mohamed Salleh

On Mt Kinabalu at 11,000 ft altitude, November 1931.
Photograph by R.E. Holttum

principal objects of study during the preceding years. Collection of other plants was largely due to Kiah; among them were palms, which Dr Furtado was then studying, and three palms, previously unknown, were named in honour of Kiah, namely *Pinanga keahii* Furt., *Calamus kiahii* Furt. and *Licuala kiahii* Furt. Kiah was an excellent colleague, always at hand when needed. He was an expert in drying specimens over an open fire without burning them, often under trying conditions; it was the only available method except for some ferns which would dry quickly without heat.

Later, when Mr M.R. Henderson was writing his monograph on the genus *Eugenia* in Malaya (Gard. Bull. vol. 12, 1949) he based two new species on specimens collected by Kiah, namely *E. kiahii* Hend. from Sungei Kayu, Johore, and *E. pseudoclaviflora* Hend. from Gunong Tahan. Kiah's collection of the orchid *Calanthe masuca* (Don) Lindl. in Kedah was the only one known from the Malay Peninsula when I wrote my book on the orchids of Malaya.

Kiah was a responsible and reliable person as well as a very observant collector and during his long service acquired a very wide knowledge of local plants. He had a very even temperament and I never saw him put out by trying circumstances. I salute his memory and remember him with thankfulness.

R. E. HOLTTUM

Ed. note: From 1949 until 1957 Kiah continued to work in the herbarium and during his later years of service worked closely with Mr. James Sinclair and with Dr. Chew Wee Lek. After his retirement, Encik Kiah remained mostly at home tending his garden and enjoying his pension. Further details concerning Kiah's collecting trips can be found in Fl. Males. I, vol. 1 (1950) 280 and I, vol. 8 (1974) LV.

Book Review

HANDBOOKS OF THE FLORA OF PAPUA NEW GUINEA. Volume II. Edited by E. E. Henty, Senior Botanist, Office of Forests. Melbourne University Press (on behalf of the Government of Papua New Guinea) Pp. × + 276, text figures 62, I fold-out map, 1981. ISBN 0 522 84204. 6. Recommended retail price: A$ 30.00.

This volume, the second in a new series (of which the first was edited by J.S. Womersley) continues the pattern of the first volume. Identical in size and only 2 pages shorter, attractively cloth-bound in green, and with a white dust-jacket with black print and a plant drawing in green (each drawing unique to a volume), the "Handbooks" series is both practical and good-looking. Taxonomic treatments of various families as they occur in Papua New Guinea are included, in alphabetical order within each volume, in no particular systematic order, but rather in the practical order of publication as and when research is completed. In volume 11, six authors contribute treatments of 14 families, these being BIXACEAE, BOMBACACEAE, COCHLOSPERMACEAE, HAMAMELIDACEAE, HERNANDIACEAE, and STYRACACEAE, by J.R. Croft; CHENOPODIACEAE by A. Kanis; CORIARIACEAE by B. J. Conn; DAPHNIPHYLLACEAE, JUGLANDACEAE, STACKHOUSIACEAE, and STAPHYLAEACEAE by W. R. Barker; and ELAEOCARPACEAE by M.J.E. Coode; and LORANTHACEAE by B.A. Barlow. The treatments vary greatly in length, that of the Elaeocarpaceae by Coode being about 150 pages long, i.e. over half the length of the book. The Loranthaceae, by Barlow, is a treatment of 48 pages and the second in length in the volume. Several of the treatments therefore are extremely short, treating one or only a few species. However, the formats are identical. A considerable part of the value of the book is the relative abundance and generally high quality of the illustrations, which are by several artists, including Faye Owner, Terry Nolan, S. Hitingnuc, Taikika Iwagu, and Bore Doviong. The absence of photographs, however, seems odd; the line-drawings are the best presentation of botanical detail, but the inclusion of some habit/habitat photos would have enhanced the utility of the book.

The treatment of Elaeocarpaceae is the "main course" and in it five genera are revised for Papua New Guinea: *Sloanea, Dubouzetia, Sericolea, Aceratium,* and *Elaeocarpus*. In *Aceratium,* there are 12 species; in *Dubouzetia,* 4; (possibly a 5th, undescribed, exists also); in *Elaeocarpus,* 69 species, plus 8 more mentioned but unnamed and not yet described (as well as a plethora of unknowable names based on type materials destroyed in the Berlin herbarium during World War II); *Sericolea,* 9, plus 2 unnamed but described species; *Sloanea,* 18 species. Thus there are at least 102 species, as well as those unnamed which would total another eleven, giving a grand total of 113 species. This is a thorough treatment (the outcome of long study by Coode, both in Papua New Guinea and later at Kew). It should be noted that a revision of *Sericolea* by M.M.J. van Balgooy of Leiden has recently appeared (*Blumea* 28: 103-141, 1982). In this work, van Balgooy supplements

Coode's treatment with the addition of two new species (one of this is the "Species A" of Coode, the other being the E. Highlands (Mt. Piora) specimen referred tentatively to *S. ridleyana* (Wernham) Schlechter by Coode. Balgooy also describes some other subspecies, and in a few minor ways further differs from Coode's treatment.

Barlow's treatment of Loranthaceae is the other larger component of the volume, with 12 genera and 55 genera and 55 species. The bulk of the species (27) belong to one genus, *Amyema.*

The volume includes an Appendix, listing ("Census") of the families of Flowering Plants and Gymnosperms known in Papua New Guinea. There are 210 families listed. There is good index to both scientific and vernacular names.

For each species text material is organized under several headings: name and nomenclature; description; field characters; distribution; ecology; and additional notes.

In general the standards displayed in the book are high, including the botanical research and the physical characters of the volume itself.

Undoubtedly it will play a useful role in Papua New Guinea, a developing country with a vast array of plant resources but which are often very poorly known, and with many insufficiently explored regions.

It can be expected that many of the species which occur in Papua New Guinea will also occur in West Irian, as the dividing line between these two political entities is entirely artificial. In addition, many Papua New Guinea species occur to the East in the Bismarck Archipelago and the Solomon Islands; indeed, the former area is included in the flora (as it is politically).

The Handbooks series is a cooperative effort, well edited, and we look forward to further volumes in the series.

B.C. STONE

Department of Botany
University of Malaya
Kuala Lumpur, Malaysia

Review

THELYPTERIDACEAE by R. E. Holttum. Flora Malesiana, Series II, Volume 1, part 5: i-xx, 331-599 (total 288 pp), 20 figs., publ. date 1 March 1982. Sold by Martinus Nijhoff, P.O. Box 566, 2501 CN The Hague, Netherlands, price not indicated.

Malesia is the centre of diversity for Thelypteridaceae. Studies of this fern family were until now limited by lack of information for Malesia, the area from which, after fourteen years of concentrated research and many preliminary and related papers, Professor Holttum has classified, named, keyed and described 440 species.

Thelypteridaceae may contain the most individuals, the greatest biomass, and the largest number of species of all ferns. In some habitats they are the dominant herbaceous vegetation. The family contains relictual species living in mountain forests threatened with extinction as well as spreading pantropic weeds that hybridize frequently. They range in size from delicate dwarfs, fertile when less than 5 cm high, to coarse bristly giants bearing fronds 3 m long.

One can quickly learn to recognize the family at a glance, even from fronds without sori, by the terrestrial habit and mostly pinnate fronds with narrow pinnae often regularly lobed. The cartilaginous reinforcements between lobes, the pinnate venation plan, the axes not being grooved where pinnae meet rachis, and the needle-pointed hairs, all contribute to a characteristic appearance, and the use of a hand lens for absolute confirmation is rarely necessary.

But although the family itself is very distinctive, problems in distinguishing genera and species were, until Holttum's work, probably more difficult than in any other fern family, so that everything was often lumped into a single genus, *Thelypteris*. Holttum catalogued the species of the Old World, discovering natural groups and characters that would serve for their recognition. Some key characters are conspicuous, such as whether or not the lower pinnae of a frond are reduced in size, others technical, such as type of paraphysis structure. Only after the diversity had been sorted out satisfactorily, in detail, was it practical to consider dividing the family. Only now do we have the option of whether to place all one thousand species of Thelypteridaceae in one genus, and then be often obliged to also cite a subgeneric or sectional name to indicate more precisely the meaning of a binomial, or, to divide Thelypteridaceae into smaller and distinctive genera. For choosing to divide, into 22 genera for Malesia, Holttum is not to be considered a "splitter." In previous revisions for Flora Malesiana of families Gleicheniaceae and Cyatheaceae, he decided to recognize fewer genera than many pteridologists writing afterwards. He has consistently attempted to use the genus, the first part of the latin binomial that is the name of a plant, in a way to accord it the optimal taxonomic significance between family and species, while thinking on a world scale.

For defining species of thelypterids, information about the characteristics and distribution of hairs and glands was discovered by Holttum to be very valuable.

Such details were dismissed by many previous botanists as unimportant, or were unobserved. At the species level alone, how much an advance of knowledge this revision represents can be indicated by comparing it with a work from an area thought to be well-studied, Copeland's Fern Flora of the Philippines (1960), in which 100 species now considered thelypterids were included. Holttum accounts for 116 Philippine species, but more than half of these are not the same as Copeland's, many of which had to be reduced to synonymy or were misinterpretations.

As Holttum states, "no classification can be final." Some species will be found to require remodeling. New species remain to be collected; only now can they be recognized as such. Probably some generic boundaries will have to be adjusted, and at least one relationship with a New World group needs clarification. But this may well be the final synthesis, for this subject, of such a vast amount of information. I think it very unlikely that ever again anyone will, with comparable talent, experience, energy, and facilities, attempt to address this family in detail at its centre of diversity. However, a great amount of local work remains to be done in most parts of Malesia, work that will be given impetus by this publication.

This part five completes volume one of the Pteridophyta for Flora Malesiana. It begins with an elegant discourse on the history of fern classification, also by Holttum, emphasizing the towering role of Carl Christensen, to whom the volume is dedicated.

M.G. PRICE,
Herbarium, NUB
University of Michigan
Ann Abor, MI 48109, U.S.A.

OBITUARY

Murray Ross Henderson, Director 1949-1954

Mr. Henderson was born at Banchory, Aberdeenshire, in 1899 and died at Aberdeen in October 1982, a few days after his 83rd birthday. Immediately after World-War I he studied botany at the University of Aberdeen, where W.G. Craib was Professor. Craib had then already made considerable progress in his studies of the flora of Thailand, and thus Henderson became interested in the botany of tropical Asia. This led in 1921 to his appointment as botanist in the Museums Department of the Federated Malay States. He was at first stationed at Taiping, within the area whence a large part of the collections which formed the basis of King & Gamble's Materials for a Flora of the Malay Peninsula had been made, so that he had a good guide to local plants. He later transferred to the Museum at Kuala Lumpur and collected in that area, visiting Fraser's Hill in 1923. In 1924 he was appointed Curator of the Herbarium in the Botanic Gardens, Singapore, a post which he retained until he was appointed Director in 1949.

In subsequent years Mr. Henderson organized many of the collecting expeditions in the Peninsula which were undertaken each year from the Gardens, adding greatly to knowledge of the flora of what was then known as British Malaya; details of his travels are recorded by Mrs van Steenis in her Cyclopaedia of Collectors in the first volume of Flora Malesiana (1950) p.225. He developed a special interest in plants of the limestone and made collections on most of the limestone hills in Selangor, Pahang, Kelantan, Perak and Kedah, including the Langkawi Islands. In 1939 he collated the information so obtained in an important paper published in the Journal of the Malayan Branch, Royal Asiatic Society (vol. 17: 13-87, with plates 3-12). His other major original publication was his monograph of the genus *Eugenia (sensu lato)* in Malaya (Gard. Bull. Singapore 12: 1-293; 1949). In this he showed clearly that a subdivision of *Eugenia* cannot be based on characters of seeds and seedlings, as proposed by some authors, and specified aspects of floral morphology which he believed could be the basis of a subdivision, though he preferred to retain a broad concept of the genus.

Henderson's main work throughout was the identifying of specimens, collected by himself and others, which were added to the Herbarium, duplicates of many being distributed (on an exchange basis) to other herbaria, thus enriching the Singapore Herbarium in two ways and adding to the permanent records available for specialists to study. He corresponded frequently with botanists at Bogor and elsewhere, and arranged for loan of specimens to them, thereby helping to correlate knowledge across political boundaries.

He left Singapore towards the end of 1941, returning in December 1945 to help in the post-war rehabilitation of the Gardens. During part of his absence he lived in South Africa and studied some plants of that country, especially Cycads, based on the National Botanic Garden at Kirstenbosch.

Murray Ross Henderson (1899-1982)
Photograph taken in 1955.

After World-War II he performed a useful service to Malaya by compiling his fully illustrated popular works on Malayan Wild Flowers, which have done so much to promote an understanding of local plants. His account of the Dicotyledons appeared in three issues of the Malayan Nature Journal in 1949-1951; these were reprinted in one volume by the Malayan Nature Society in 1959 and again in 1974. The Monocotyledons form the subject of a separate volume published by the Malayan Nature Society in 1954 and was reprinted in 1974.

R.E. HOLTTUM

INDEX
Vol. XXXV

Basionyms and synonyms appear in italics. Names of fauna are in large and small caps. Page numbers in italics indicate the presence of illustrations.

INSTRUCTIONS TO AUTHORS

Manuscripts: The Editorial Committee of the Gardens' Bulletin will be glad to receive and consider for publication original research findings and reviews of progress in the fields of botany, horticulture, and allied subjects. Contributions must be original and the material must not have been submitted or, if accepted, be submitted for publication elsewhere.

Two copies of the manuscript should be submitted, typed on one side only with double-line spacings and a margin of at least 4 cm. Do not type all the letters of any word in capitals. Underline only in pencil: with a straight line for italic type face and wavy line for bold type face. Authors should see the layout of other papers recently published in this journal to ensure that papers submitted conform as closely as possible to the accepted pattern. Numerical data should only be included if it is essential to the argument and this can be presented either in the form of tables or diagrams.

Title and authors: The title should give a concise description of the contents of the papers. The name(s) of author(s) and address(es) must be given below the title. Lengthy papers and those of a taxonomic nature must have the contents listed at the beginning of the paper.

Scientific names: The complete scientific name — genus, species, authority, and cultivar where appropriate — must be cited for every organism at time of first mention. The generic name may be abbreviated to the initial thereafter except where intervening references to other genera with the same initial could cause confusion.

Tables: All tables should be numbered and carry headings describing their content. These should be comprehensive without reference to the text.

Abbreviations: Standard chemical symbols may be used in the text (e.g. IAA, IBA, ATP), but the full term should be given on the first mention. Dates should be cited as: 3 May 1976. Units of measurement should be spelled out except when preceeded by a numeral where they should be abbreviated in standard form: g, mg, ml, etc. and not followed by stops.

Literature citations: Citations in the text should take the form: King and Chan (1964). If several papers by the same author in the same year are cited, they should be lettered in sequence (1964a), (1964b), etc. When papers are by up to three authors should be cited as: Geesink et al. (1981). All references must be placed in alphabetic order according to the surname of the (first) author and in the following form:

Singh, H. (1967). Sclerids in *Fagraea. Gard. Bull. Sing.* 22, 193-212.

Abbreviations of titles of journals should be those of the World List of Scientific Periodicals (4th Edition) or the Selected Abbreviated Titles of Biological Journals (London: Institute of Biology).

References to books and monographs should be cited according to the following form:

Ridley, H. N. (1930). *The Dispersal of Plants Throughout the World,* L. Reeve; Ashtord, Kent; 242-255.

For literature citations in taxonomic papers the following style is required:

Medinilla alternifolia Bl., Mus. Bot. Lugd.-Bat. I:2 (1849) 19.
Sterculia acuminatissima Merr., Philip. J. Sci. 21 (1922) 524.

Illustrations: Drawings should be done in India ink. Authors should indicate where individual illustrations receive first mention in the text.

Offprints: Authors will be given 50 offprints gratis. Additional copies must be ordered and paid for, prior to publication.

Manuscripts should be sent to: THE EDITOR, GARDENS' BULLETIN SINGAPORE, BOTANIC GARDENS, CLUNY ROAD, SINGAPORE 1025.

PUBLICATIONS OF THE BOTANIC GARDENS SINGAPORE

1. **The Agricultural Bulletin of the Malay Peninsula (Series I).**
   Only nos. 3, 5, 7, 8 and 9 available at 20 cents each.

2. **The Agricultural Bulletin of the Straits and F.M.S. (Series II).**
   Vols. 1-10, 1901-1911, monthly issues.
   Many parts available.
   Price: $5 per volume, 50 cents per part.

3. **The Gardens' Bulletin, Straits Settlements (Series III).**
   Vols. 1-11, 1912-1947.
   Vol. 1 (1-5) January-May 1912 issued under the title of **Agricultural Bulletin of the Straits & F.M.S.**
   Prices on application.

4. **The Gardens' Bulletin, Singapore (Series IV).**
   Vols. 13-32, 1949-1979.
   Price: Vol. 13 $20 per vol., Pt. I (new impression) $12 per copy; Vol. 14 $13 per vol.; Vol. 17 Pt. III $12.50; Vols. 18 & 19 $25 per vol.; Vol. 20 Pt. I $8.00, Pt. III $5.00; Vol. 21 Pt. II $5; Vols. 22-25 $25 per vol, Vol. 26 (Pt. I $18; Pt. II $18); 27 (Pt. I $18; Pt. II $18.50); 28 (Pt. I $18; Pt. II $15); 29 ($30); 30 ($48); 31 (Pt. I $10; Pt. II $12.50); 32 ($15.50); The Freshwater Swamp-forest of S. Johore and Singapore by E.J.H. Corner (Gard. Bull. Sing. Suppl. 1) — $35; Vol. 33 (Pt. I $21.50; Pt II $12.50; Index $1.90; Vol. 34. (Pt I $21.50; Pt. II $11.50); Vol. 35 (Pt. I $17.50).

5. **Materials for a Flora of the Malay Peninsula, Monocotyledons.**
   Parts 1, 2 and 3 remain available.
   Price: $10 per set, $5 per part.

6. **Annual Reports.**
   1909-1972.

7. (a) **Malayan Orchid Hybrids by M.R. Henderson and G.H. Addison,** $15 (1969)
   (b) **Malayan Orchid Hybrids, Supplement I by G.H. Addison,** $21 (1961, out of print).

8. **A Revised Flora of Malaya.**
   (a) Vol. 1, Orchids by R.E. Holttum, $50 (3rd ed. 1980 Impr.)
   (b) Vol. 2, Ferns, by R.E. Holttum, $20 (2nd ed. 1968).
   (c) Vol. 3, Grasses, by H.B. Gilliland, $30 (1971).

9. *Boletus* **in Malaysia by E.J.H. Corner,** $50 (1972).

Items 1-6 obtainable from the Commissioner, Parks & Recreation Department, Botanic Gardens, Cluny Road, Singapore 1025; tel. nos. 4741165, 4741134.

Items 7-9 obtainable from Singapore National Printers (Pte) Ltd, Upper Serangoon Road, Singapore 1334, tel. no. 2820611 and their Sales Division, G29 International Plaza, Anson Rd, Singapore 0207, tel. no. 2230834

Prices quoted are in Singapore Dollars
Overseas postage is extra